DOD/VHA CLINICAL PRACTICE GUIDELINE
FOR THE MANAGEMENT OF

ASTHMA
FOR ADULTS AND CHILDREN AGE 6 YEARS AND OVER

Department of Defense
Veterans Health Administration

Prepared by:

THE MANAGEMENT OF ASTHMA

Working Group

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INTRODUCTION

VHA/DOD CLINICAL PRACTICE GUIDELINE FOR THE MANAGEMENT OF ASTHMA

Introduction

Asthma is a chronic inflammatory disease of the lungs characterized by episodic and reversible airway obstruction. In the United States, rates of asthma have been increasing over recent decades in all age and racial groups, from an average of 30.7 per thousand to 53.8 per thousand in 1994 (1). In 1998, asthma affected an estimated 17.3 million persons in the United States, including over 4.8 million children (2). Asthma mortality and morbidity have also been on the rise, with asthma accounting for more than 5000 deaths, 1.87 million emergency department visits, and over 100 million restricted activity days in 1995 (1).

With the appropriate use of available therapies, asthma exacerbations and their consequences can be effectively controlled. The purpose of this clinical practice guideline is to help clinicians and patients make appropriate decisions about asthma care. This guideline can assist primary care providers or specialists in the diagnosis and initial management of symptoms, follow-up management and assessment of the ongoing clinical situation, emergency management of acute exacerbations, determination of appropriate treatment, and delivery of individualized interventions. This guideline has been developed with a broad range of clinical settings in mind and should be applied with enough flexibility to accommodate local practice and individual situations.

Guideline Development Process

Since 1998, the selection of guideline topics and the guideline development process have been under the joint auspices of the Veterans Health Administration (VHA) and the Department of Defense (DoD) pursuant to directives from the Department of Veterans Affairs Undersecretary for Health and the DoD Assistant Secretary of Defense, Health Affairs. Asthma was selected based on its prevalence in the VHA and DoD populations, the risks that are associated with this condition, and the mitigating effects of early diagnosis and preventive treatment on the frequency and severity of asthma symptoms and mortality.

The guideline development process follows from the definition of clinical practice guidelines used by the VHA and DoD (3,4):

> Recommendations for the performance or exclusion of specific procedures or services derived through a rigorous methodological approach that includes the following:
>
> 1. Determination of appropriate criteria, such as effectiveness, efficacy, population benefit, or patient satisfaction; and
> 2. Literature review to determine the strength of the evidence in relation to these criteria.

This clinical practice guideline updates the 1997 version of the VHA Guideline on Management of Persons with Asthma, a guideline aimed at the management of adult patients. The current guideline consists of two sections: one on the management of asthma for adults and children 6 years and over and a second on the management of asthma for infants and children under 6. The goal in developing this guideline was to incorporate information from existing, national recommendations into a format, which would maximally facilitate clinical decision-making (5). This effort drew heavily from the National Heart, Lung and Blood Institute's National Asthma Education and Prevention Program Expert Panel Report 2, *Guidelines for the Diagnosis and Management of Asthma*, published in July 1997 (6).

The 1997 guideline was the product of a research and consensus building effort among professionals from throughout the VHA. Work on this updated guideline for the Management of Asthma was started in November 1998, at a meeting that also updated a companion guideline, the Management of Chronic Obstructive Pulmonary Disease. The expert panel convened in 1998 included new participants from the DoD, VHA and academia as well as many of those involved with the 1997 VHA asthma guideline and a team of private guideline facilitators. An experienced moderator facilitated the multidisciplinary panel (including internists, family practitioners, pediatricians, pulmonologists, allergists, nurse practitioners, physician assistants, nurses, pharmacists, and health educators) in developing an updated asthma guideline appropriate for adults and children old enough to cooperate with spirometry. A smaller group of experts and primary care providers who work with infants and young children spent an additional day adapting the asthma guideline for use with children too young for spirometry. The process is evidence-based whenever possible. Where evidence is ambiguous or conflicting, or where

scientific data are lacking, the clinical experience within the room was used to guide the development of consensus-based recommendations.

The clinical experts subjected all decision points in the algorithm to simulation exercises. A variety of hypothetical "patients" were run through the algorithm to test whether it was likely to work in a real clinical situation. Whenever an irregularity was encountered, changes were made. The clinical experts are thus reasonably confident that the algorithm will prove to be useful in real clinical encounters.

We are confident that the current guideline represents a significant step forward for primary health care in the DoD and VHA by promoting evidence-based management for persons with asthma. However, it is only the first step in the mission to improve the care of those with asthma. In the future, the challenges will be in:

- Guideline implementation
- Guideline promotion
- Development of teaching tools for graduate and continuing medical education
- Development of automation tools that include:
  - Provider specific report cards
  - Performance monitors that assist the practitioner/facility in outcome tracking based on guideline use.

Clinical guideline algorithms provide a basis for local development of more specific clinical pathways. Pathways are clinical management tools that organize, sequence, and specify the timing for the major patient care activities and interventions of the entire interdisciplinary team for a particular diagnosis or procedure. Clinical pathways define key processes and events in the day-to-day management of care and often serve as a component of the patient record. Variance from the pathway along with causes of divergence should be documented. Clinical pathways should be developed locally, as they are specific to the particular setting where utilized.

The system-wide goal is to improve local management of patients with asthma and thereby improve patient outcomes. The guideline/algorithms are designed to be adapted to an individual facility's needs and resources. They will also be updated periodically or when relevant research results become available. The guideline should be used as a starting point for innovative plans that improve collaborative efforts and focus on key aspects of care.

The clinical practice guideline is presented in an algorithmic format. There are indications that this format improves data collection and clinical decision-making and helps to change patterns of resource use. A clinical algorithm is a set of rules for solving a clinical problem in a finite number of steps. It allows the practitioner to follow a linear approach to the recognition and treatment of asthma. It is recognized, however, that clinical practice often requires a nonlinear approach, and must always reflect the unique clinical issues in an individual patient-provider situation. The use of guidelines must always be considered as a recommendation within the context of a provider's clinical judgment in the care for an individual patient.

A clinical algorithm diagrams a guideline into a step-by-step decision tree. The steps in this tree are represented as a sequence of actions (rectangle "do boxes") and questions (hexagonal "decision boxes"). A letter within a box of an algorithm refers the reader to the corresponding annotation. The annotations elaborate on the recommendations and statements that are found within each box of the algorithm. These annotations include a reference, when required, and evidence grading for each recommendation. The strength of the recommendation (SR) and the level of the evidence (LE) are both noted. The reference list at the end of each annotation includes all the sources used—directly or indirectly—in the development of the annotation text. A complete bibliography is provided at the end of the document.

Literature

The literature supporting the decision points and directives in this guideline is referenced throughout the document. Because this guideline is an update of the VHA asthma guideline developed in 1997, the literature search in support of the update focused on literature published after 1996 related to the population being studied (adults and children) and the treatment setting (primary care). Queries were developed under the guidance of members of the DoD/VHA expert panel.

The search was carried out using the National Library of Medicine's (NLM) MEDLINE database. The Medical Subject Headings (MeSH) included: (Diseases; Respiratory Tract Diseases; Respiratory Tract Diseases - Bronchial Diseases; Respiratory Tract Diseases - Respiratory Hypersensitivity; Lung Diseases; Lung Diseases - Obstructive; Immunologic Diseases - Hypersensitivity, Immediate - Respiratory Hypersensitivity; Asthma). Selection of articles was then based on key therapies in asthma, study characteristics, and study design.

The literature search was followed by critical analysis of the literature, primarily by the clinical experts. To promote an evidence-type approach, the quality of evidence was rated using a hierarchical rating scheme. The value of a hierarchical rating scheme is that it provides a systematic means for evaluating the scientific basis for health care services (7). The rating scheme used for this guideline is based on a system used by the Agency for Health Care Policy and Research. Decision points in the algorithm are annotated, and the primary source documents for the annotation are graded. The grading schemes used for this guideline are:

STRENGTH OF RECOMMENDATION GRADING (8)

Grade	***Strength of Recommendation***
1	Usually indicated, always acceptable, and considered useful and effective.
2a	Acceptable, of uncertain effectiveness, and may be controversial. Weight of evidence in favor of usefulness/effectiveness.
2b	Acceptable, of uncertain effectiveness, and may be controversial. Not well established by evidence, can be helpful and probably not harmful.

LEVEL OF EVIDENCE GRADING

	Level of Evidence Grading = A	***Level of Evidence Grading = B***	***Level of Evidence Grading = C***
Primary Evidence	Randomized clinical trials	Well-designed clinical studies	Panel consensus
Secondary Evidence	Other clinical studies	Clinical studies related to topic but not in this clinical population	Clinical studies related to topic but not in this clinical population

Performance Measurement

The inability of consumers and health care purchasers to determine if medical care is appropriate and effective has given rise to the concept that the health care system should be held accountable for what is done and the outcomes achieved. This principle of accountability has resulted in the development of so-called "performance and outcome measures," administered through "report card" systems. Measures must be seen as fair and reasonable, and able to be carried out in various practice settings.

Performance measures are indicators or tools to assess the level of care provided to populations of patients. The measures are constructed to make the best use of the evidence available for assessing care or outcomes in systems where patient characteristics (e.g. co-morbidity) and compliance cannot be easily determined and taken into consideration (i.e. the measures are not case-mix adjusted). Along with the work on guideline development, both VHA and DoD are developing and disseminating companion performance measures.

Overview of the Guideline

This guideline consists of eight modules divided into two major sections: management of asthma for adults and children 6 years and over (A1a-A4a) and management of asthma for children under 6 (A1p-A4p).

1. Asthma diagnosis and initial management for adults and children age 6 years and over (A1a)
2. Asthma treatment follow-up management for adults and children age 6 years and over (A2a)
3. Asthma emergency management for adults and children age 6 years and over (A3a)
4. Asthma telephone triage management for adults and children age 6 years and over (A4a)
5. Asthma diagnosis and initial management for infants and children under 6 years old who cannot perform spirometry (A1p)
6. Asthma treatment follow-up management for infants and children under 6 years old who cannot perform spirometry (A2p)
7. Asthma emergency management for infants and children under 6 years old who cannot perform spirometry (A3p)
8. Asthma telephone triage management for infants and children under 6 years old who cannot perform spirometry (A4p)

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(3) VHA Directive 96-053. *Roles and Definitions for Clinical Practice Guidelines and Clinical Pathways*. August 29, 1996.

(4) VA Health Services Research and Development Service Management Decision and Research Center. *Clinical Practice Guidelines: Guidelines Primer*. Boston, MA. VA HSR&D 1998.

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(6) *Guidelines on the Diagnosis and Management of Asthma: Expert Panel Report 2*, National Asthma Education and Prevention Program, National Heart, Lung, and Blood Institute. NIH Publication No. 97-4051, July, 1997.

(7) Woolf SH; DiGuiseppi CG; Atkins D; Kamerow DB. Developing evidence-based clinical practice guidelines: Lessons learned by the U.S. Preventive Services Task Force. *Ann Rev Pub Health* 1996; 17:511-38.

(8) Modified by Birch & Davis Associates, Inc. from: *AHCPR Clinical Practice Guideline No. 10. Unstable Angina: Diagnosis and Management*. March, 1994:12

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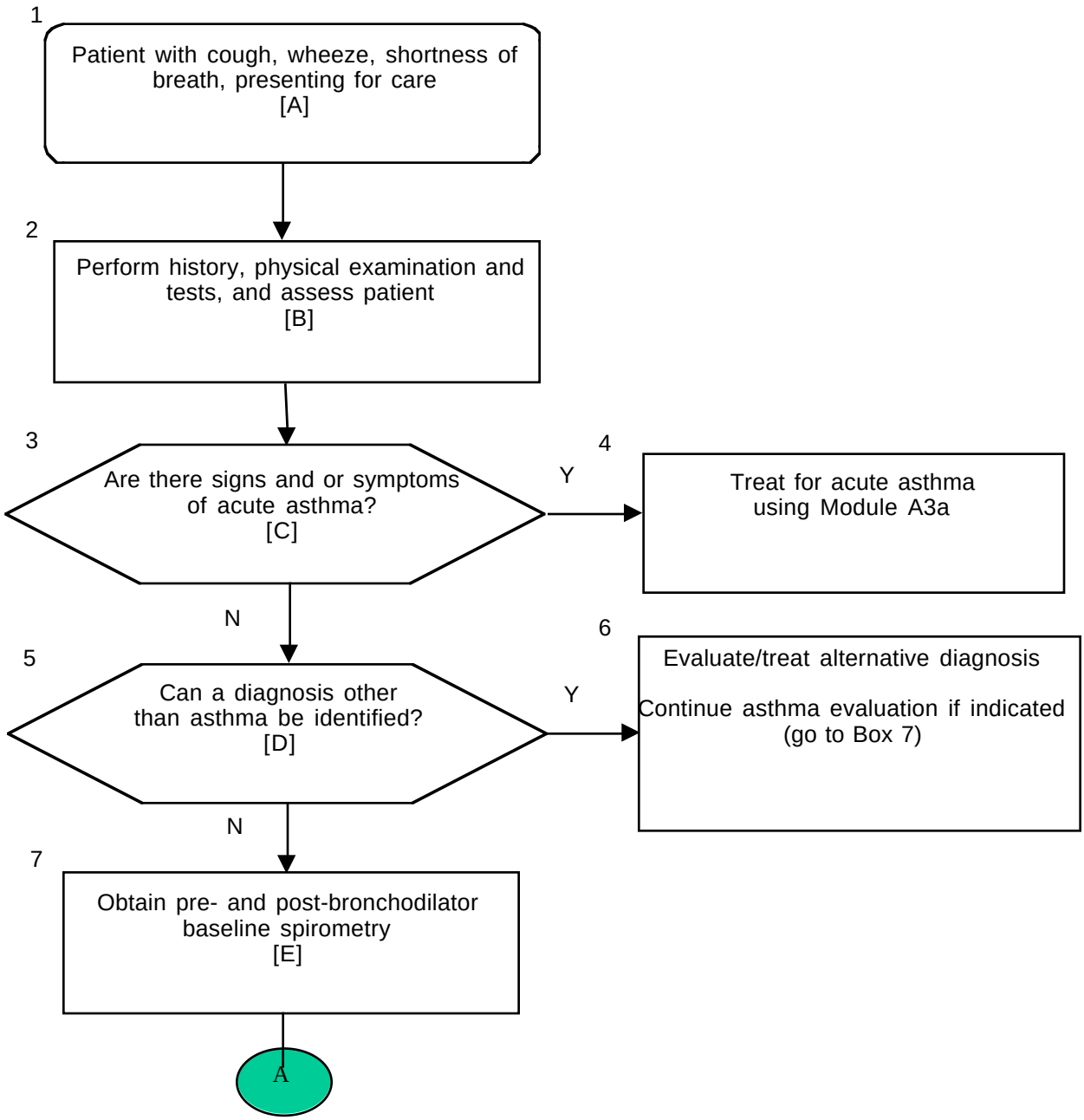
ALGORITHMS

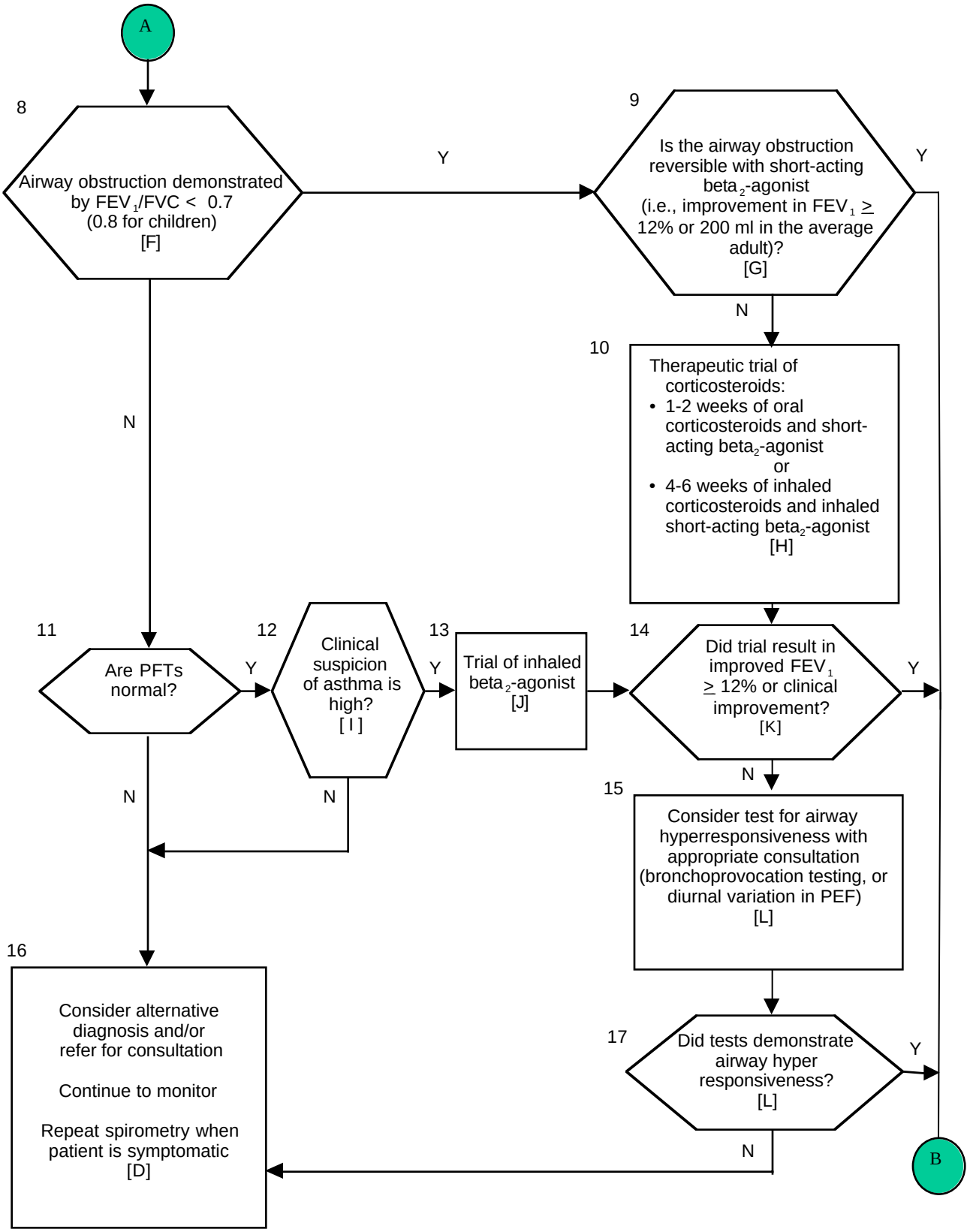
Algorithm A1a: 1 of 3

Asthma Diagnosis and Initial Management for Adults and Children Age 6 Years and Over



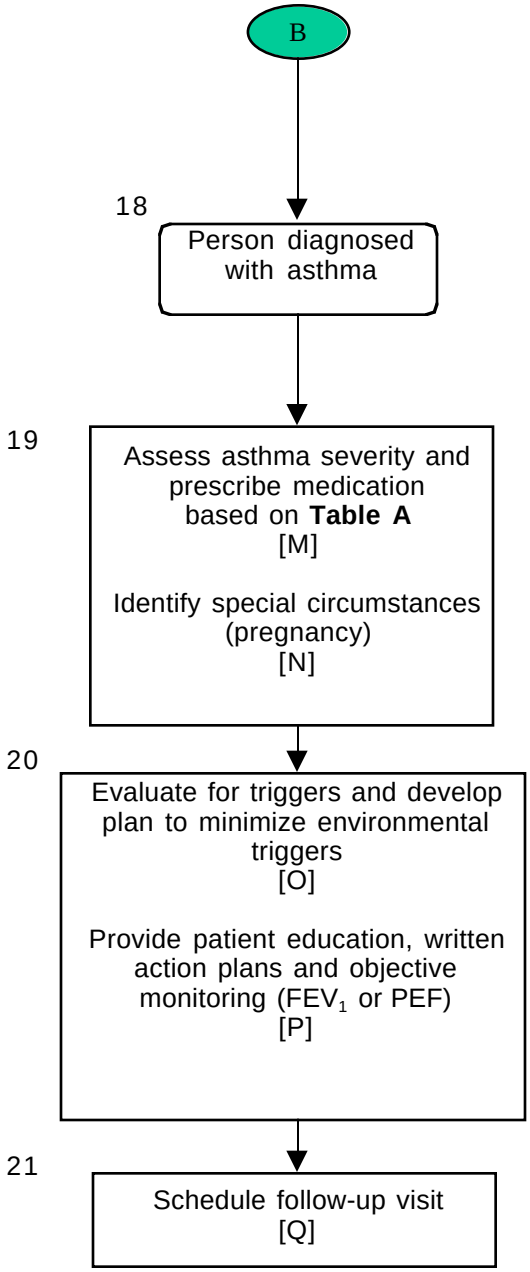
Algorithm A1a: 2 of 3

Asthma Diagnosis and Initial Management for Adults and Children Age 6 Years and Over



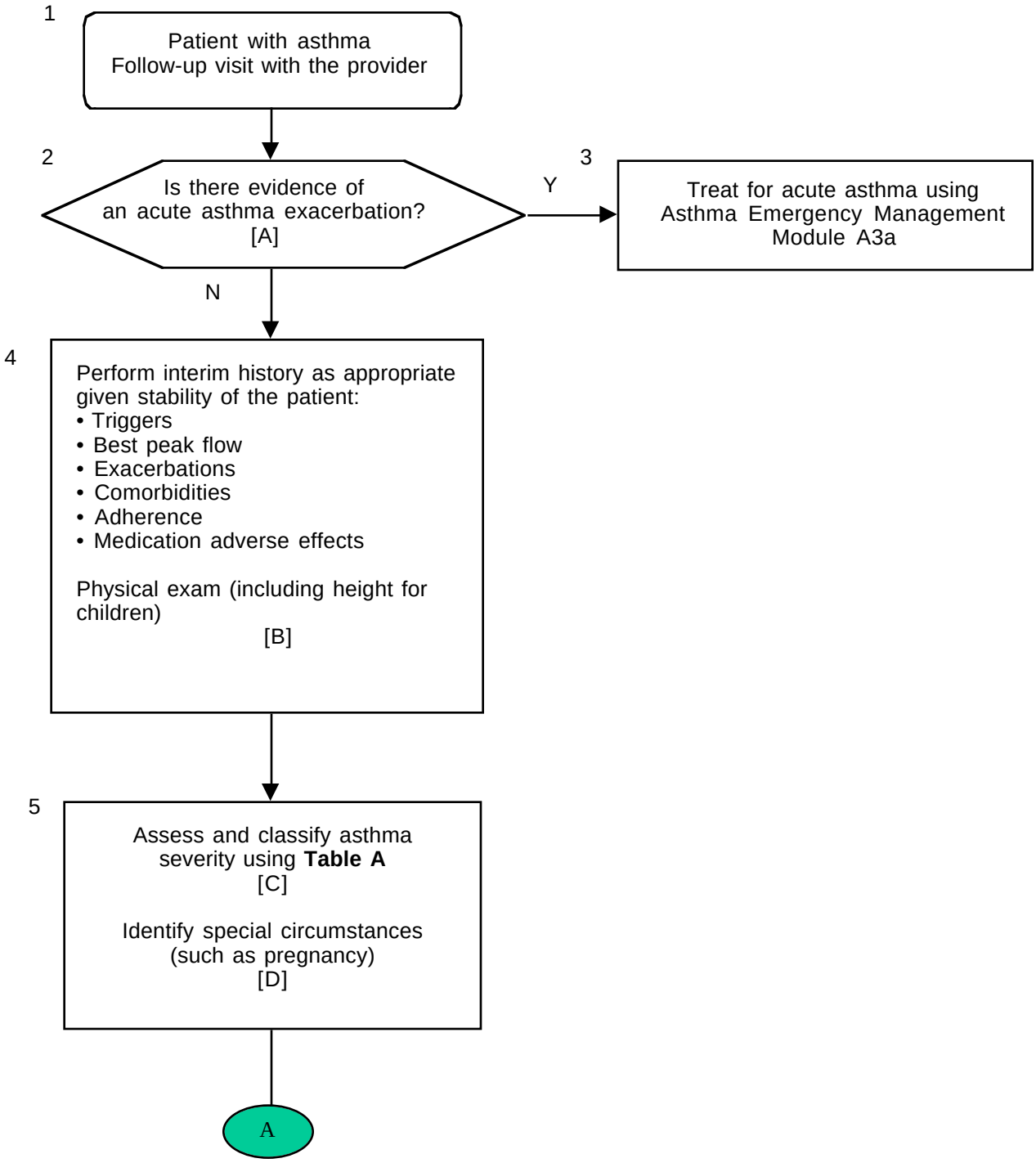
Algorithm A1a: 3 of 3

Asthma Diagnosis and Initial Management for Adults and Children Age 6 Years and Over



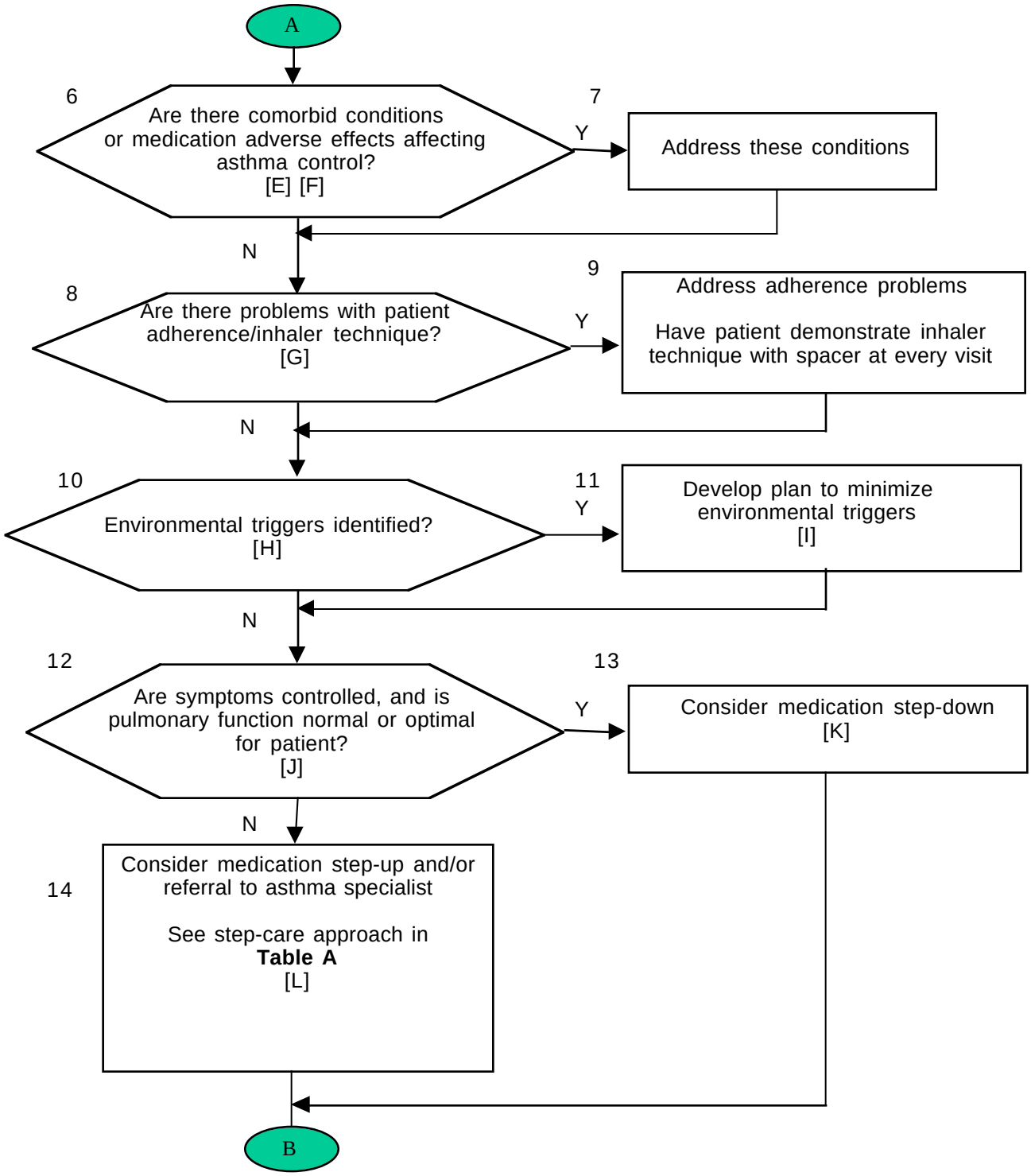
Algorithm A2a: 1 of 3

Asthma Treatment Follow-up Management for Adults and Children Age 6 Years and Over



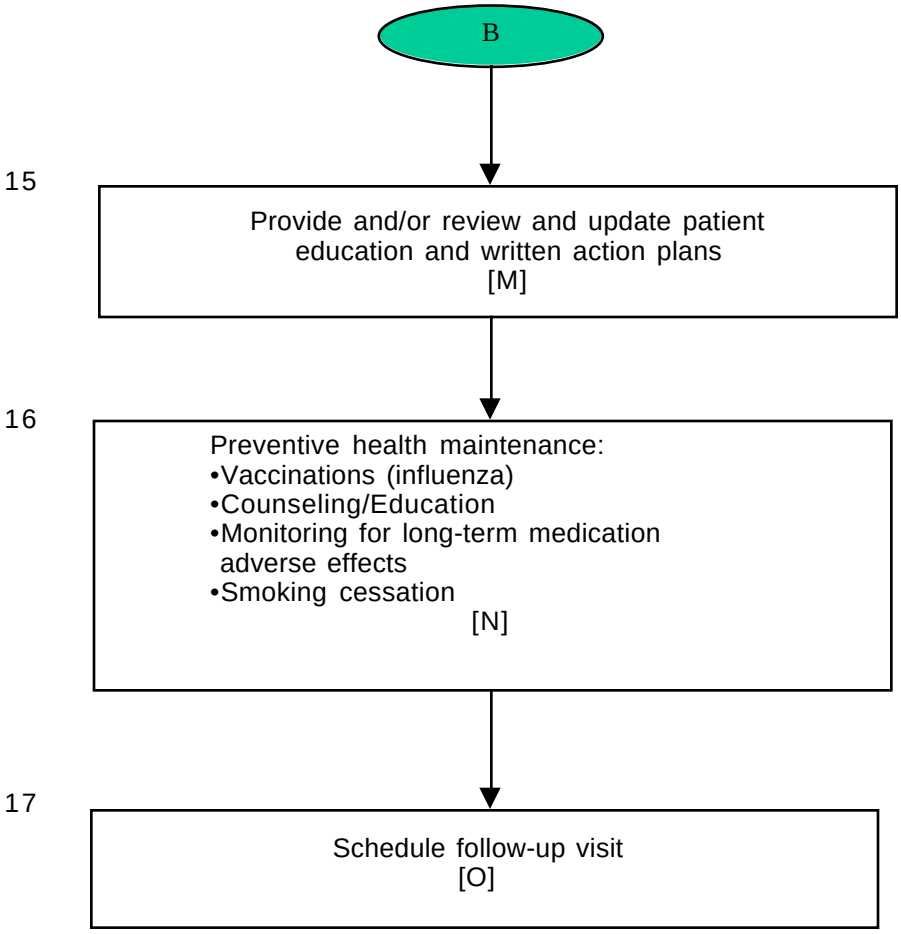
Algorithm A2a: 2 of 3

Asthma Treatment Follow-up Management for Adults and Children Age 6 Years and Over



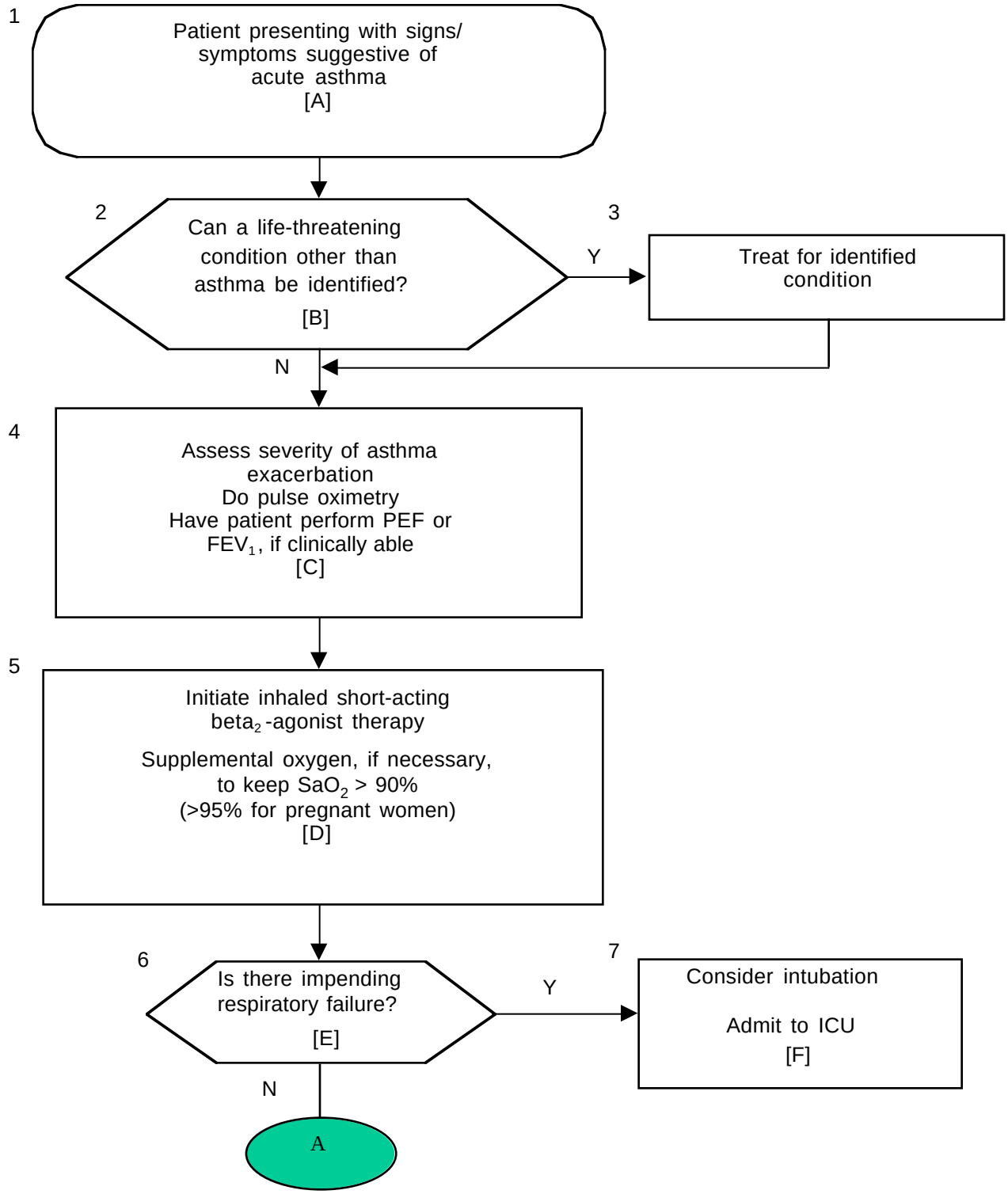
Algorithm A2a: 3 of 3

Asthma Treatment Follow-up Management for Adults and Children Age 6 Years and Over



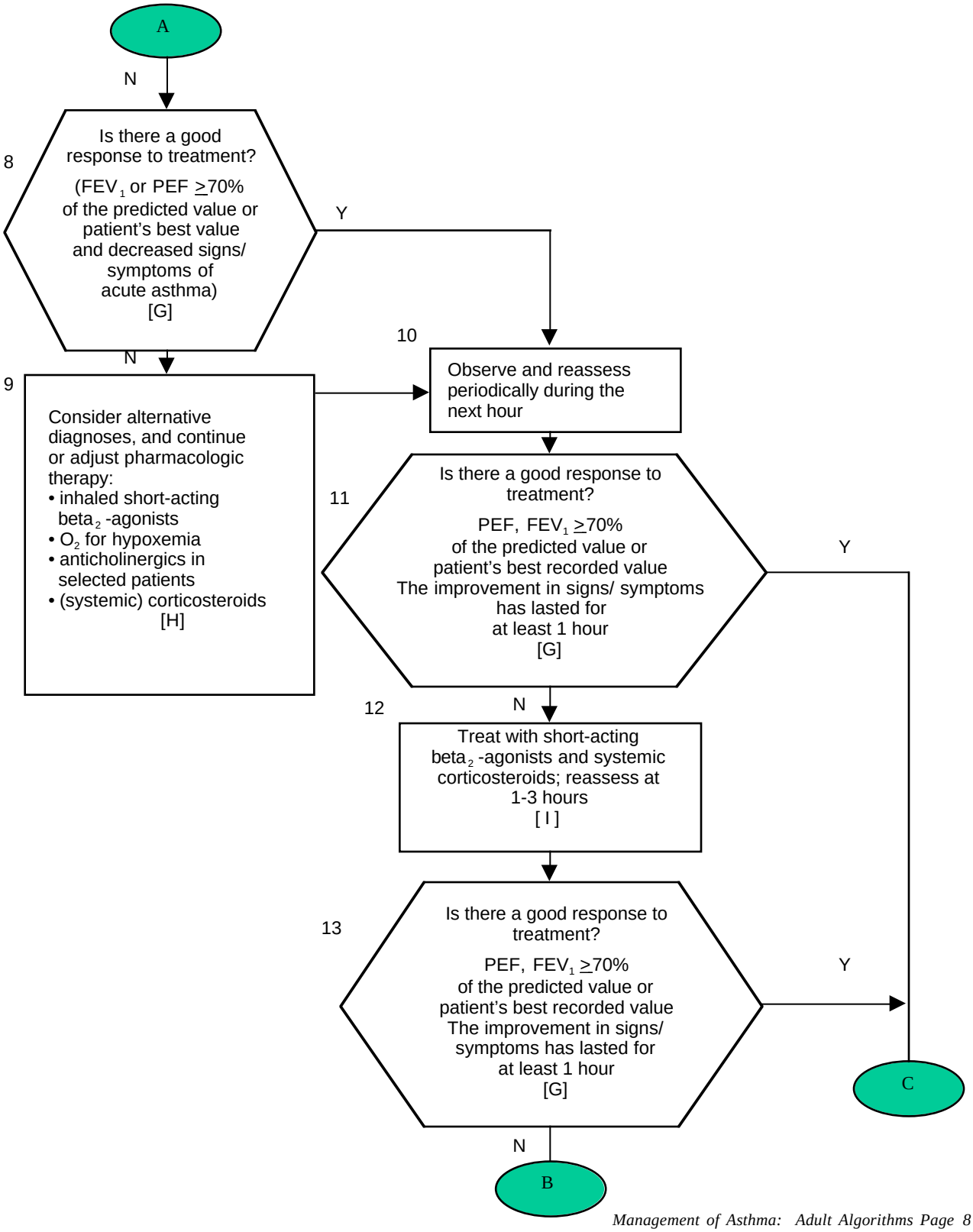
Algorithm A3a: 1 of 3

Asthma Emergency Management for Adults and Children Age 6 Years and Over



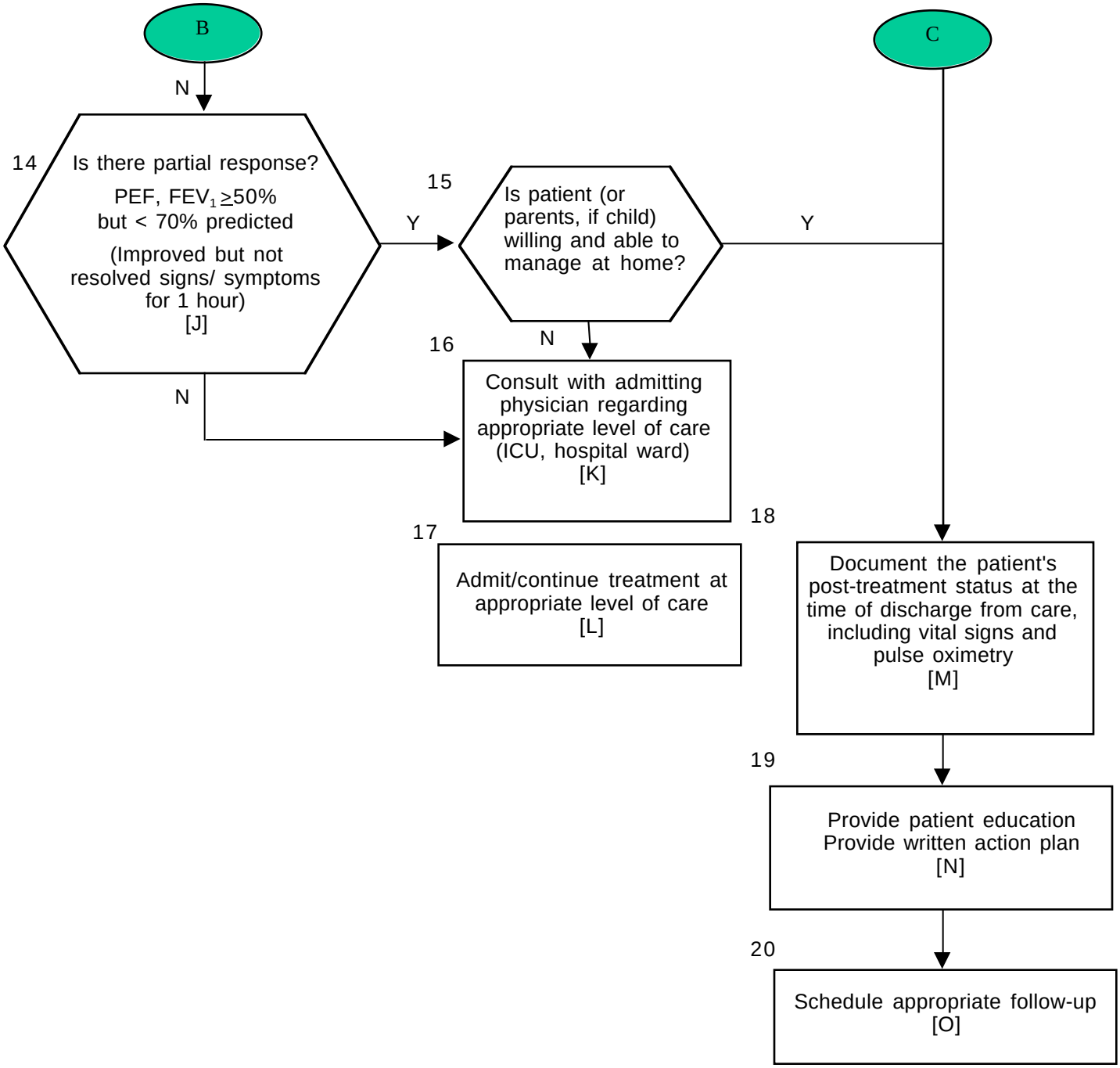
Algorithm A3a: 2 of 3

Asthma Emergency Management for Adults and Children Age 6 Years and Over



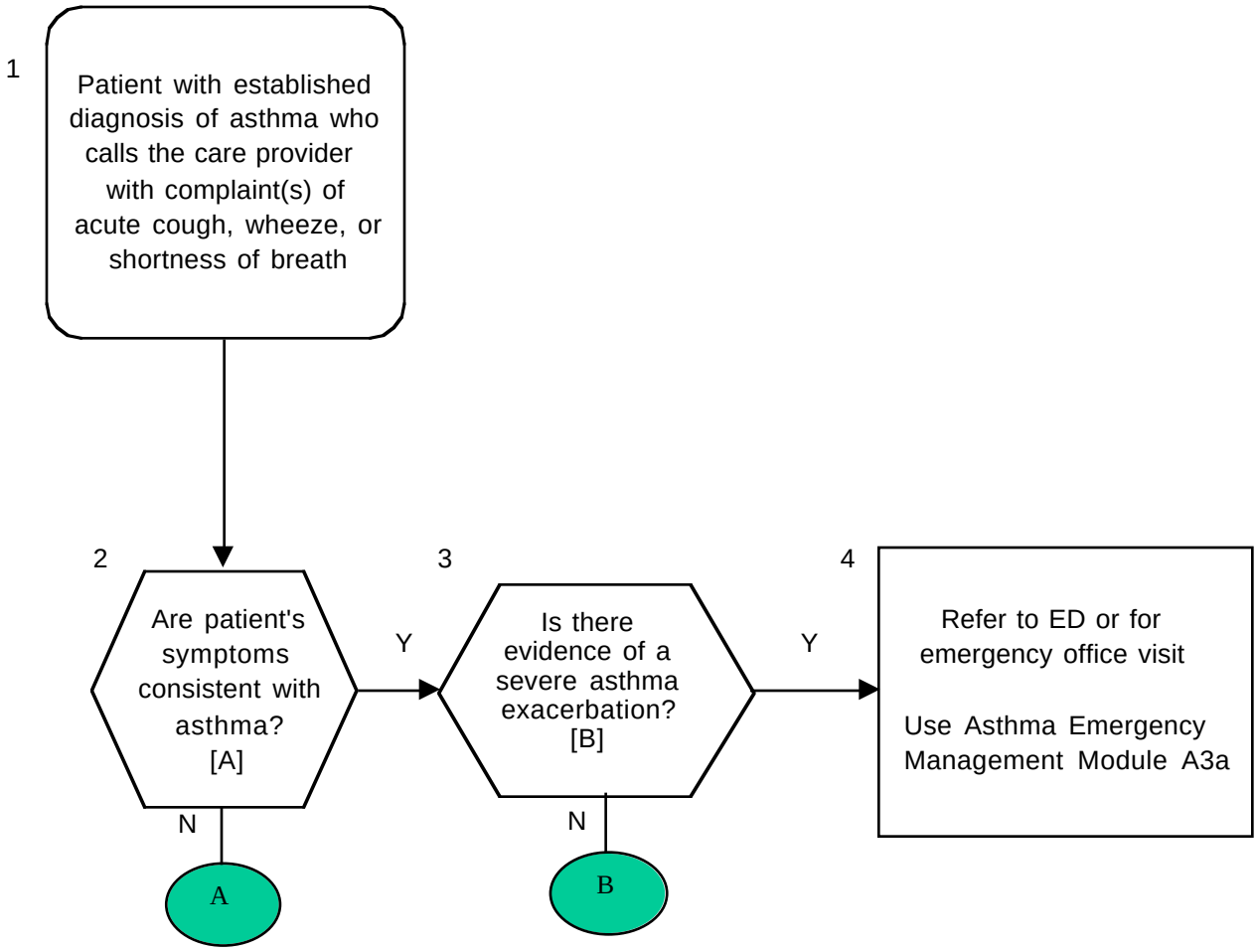
Algorithm A3a: 3 of 3

Asthma Emergency Management for Adults and Children Age 6 Years and Over



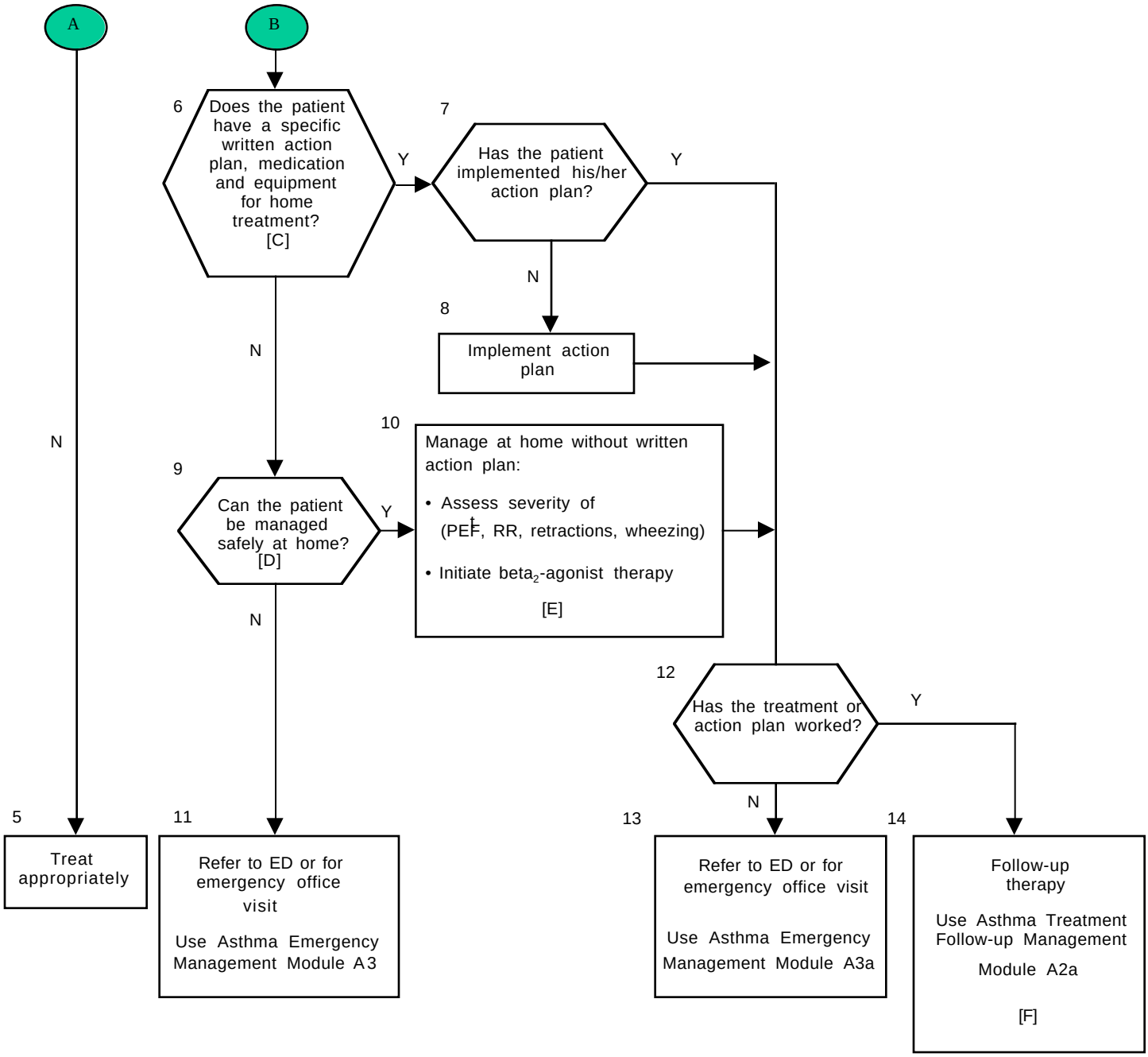
Algorithm A4a: 1 of 2

Asthma Telephone Triage Management for Adults and Children Age 6 Years and Over



Algorithm A4a: 2 of 2

Asthma Telephone Triage Management for Adults and Children Age 6 Years and Over



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ANNOTATIONS

Asthma Diagnosis and Initial Management for Adults and Children Age 6 Years and Over (A1a)

(Please note that this guideline is for patients who can perform spirometry. For those children over 6 years old who cannot perform spirometry, consider using the algorithm for infants and children under 6 years old.)

A. (Box 1) Patient with Cough, Wheeze, Shortness of Breath Presenting for Care

OBJECTIVE: To highlight common presentations of asthma

ANNOTATION:

Consider a diagnosis of asthma when there exists:

- Initial/recurrent symptoms consistent with asthma:
  - Cough
  - Wheeze
  - Shortness of breath
  - Chest tightness
  - Chest pain
  - Increased sputum production
  - Prolonged post-exertional fatigue

- History of the following:
  - Recurrent bronchiolitis or bronchitis
  - Chronic cough
  - Nighttime cough
  - Prolonged respiratory symptoms (greater than 10 days) with concomitant presumed viral upper respiratory infection (URI)
  - Recurrent pneumonia

DISCUSSION:

Asthma is under-recognized and often mislabeled (especially in children). Consider asthma if any of the following indicators are present. No one indicator is diagnostic of asthma, but the presence of multiple indicators increases the likelihood of asthma. Asthma is defined by reversible airway obstruction, which can include symptom-free intervals.

1. Wheezing, but the absence of wheezing does not exclude asthma.

2. History of any of the following: cough (especially worse at night or with exertion), recurrent wheeze, difficulty in breathing, or chest tightness.

3. Reversible airflow limitation and diurnal variability in peak flows measurements (> 20% variation between early morning pre-medication peak expiratory flow (PEF) and late afternoon PEF).

4. Symptoms occur or are made worse by: exercise, viral URI, animals with fur or feathers, house dust (mites), mold, smoke, pollen, changes in weather, strong emotional expressions, airborne chemicals, or menses.

   Other atopic disorders, such as eczema, allergic rhinitis, recurrent urticaria and recurrent croup are often present in the patient or family members.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Initial diagnosis of asthma	NAEPP EPR-2 1997	C	1

B. (Box 2) Perform History, Physical Examination and Tests, and Assess Patient

OBJECTIVE: To outline the medical history, physical exam findings, and laboratory tests that are useful in diagnosing asthma

ANNOTATION:

Important components of medical history are exercise tolerance, response to infections, respiratory response to irritants/allergens/triggers, occupation and hobbies, family history of asthma or allergy, and quantification of active/passive smoke exposure. Important associated conditions are rhinitis, sinusitis, eczema, and gastroesophageal reflux disorder (GERD).

Other important historical components are:
- Severity of symptoms (including nocturnal respiratory symptoms)
- Limitations in lifestyle (work and school performance and absences, functional status)
- Urgent-clinic and emergency department (ED) visits
- Hospitalizations, ICU admissions, endotracheal intubations
- Asthma medication use
- Environmental exposure

The physical examination for asthma focuses on:
- Vital signs
- Eyes, nose and throat
- Chest
- Skin

In addition to pulmonary function tests, lab tests which may occasionally be helpful are: evaluation of allergy to inhalants (with skin tests or with in vitro tests), complete blood count (including eosinophil count), chest radiograph, total immuno globulin E antibody (IgE), CT scan of the sinuses, sputum examination (in adults), esophageal pH probe (rule out GERD), and tuberculin skin test.

The diagnosis of asthma is based on the patient's medical history, physical examination, previous and present pulmonary function tests, and other laboratory test results.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Clinical evaluation of asthma	Li et al. 1996 Spector and Nicklas 1995	C	1
Sinusitis; association with asthma	Wald 1992 Friday and Fireman 1988	B	2a

C. (Box 3) Are There Signs and/or Symptoms of Acute Asthma?

OBJECTIVE: To recognize the signs and symptoms of acute asthma

ANNOTATION:

The quickest way to assess asthma severity is to evaluate respiratory signs/symptoms and patient comfort level.

- Usual signs/symptoms of acute asthma are cough, wheeze, shortness of breath, chest tightness, chest pain, increased sputum production, and prolonged post-exertional fatigue
- Other symptoms are anxiety, inability to lie down comfortably or sleep due to dyspnea
- Symptoms may start acutely or progress over hours to days

- Other signs of acute asthma are tachypnea, tachycardia, pulsus paradoxus, accessory respiratory muscle use, prolonged expiratory phase, hyperinflation of chest, anxiety, inability to speak in full sentences, cyanosis, confusion or lethargy
- Blood gas results may be normal in severe disease and should not be used alone to determine the severity of asthma

DISCUSSION:

The degree of wheezing may not correlate with the severity of asthma. Decreased wheezing may actually indicate worsening asthma and impending respiratory failure.

Triggers of asthma exacerbations include: exercise, URIs, respiratory irritants/allergens, active/passive smoke exposure, toxic fume inhalation, or breathing cold or dry air.

A history of previous hospitalizations (especially ICU admissions), previous need for intubation, recent ED visits and a history of severe persistent asthma all may indicate a more severe or unresponsive asthma exacerbation that may result in hospitalization.

TABLE OF EVIDENCE:

Intervention	References	Grade Of Evidence	Strength of Recommendation
Clinical assessment of asthma	Corbridge 1995 Lowenthal 1993 NAEPP EPR-2 1997	C	1
Risk factors for fatal asthma	Strunk 1987	B	1

D. (Boxes 5 and 16) Can a Diagnosis Other than Asthma be Identified?

OBJECTIVE: To identify alternative diagnoses that require treatment

Please note that the presence of an alternative diagnosis does not preclude the need for continued evaluation for asthma.

ANNOTATION:

Differential diagnosis of asthma-like findings:
- Chronic obstructive pulmonary disease (chronic bronchitis or emphysema)
- Pulmonary embolism
- Congestive heart failure
- Laryngeal dysfunction (vocal cord dysfunction [VCD]/psychogenic stridor)
- Mechanical obstruction of the airway (stenosis, tumor, foreign body)
- Pulmonary parenchymal disorders (sarcoidosis, pulmonary fibrosis, others)
- Pulmonary inflammation (eosinophils, microorganisms)
- Cough secondary to drugs (beta blockers and/or angiotensin-converting enzyme (ace inhibitors)
- Hyperventilation syndrome
- Bronchiectasis
- Cystic fibrosis
- Cough secondary to sinus infection/inflammation, cigarette smoking or GERD
- Allergic rhinitis and/or sinusitis
- Chronic aspiration
- Psychogenic cough

Additional considerations in the differential diagnosis of asthma-like findings in the child:
- Foreign body in the trachea or bronchus
- Laryngotracheomalacia, tracheal stenosis, or bronchostenosis
- Bronchopulmonary dysplasia

DISCUSSION:

Recurrent episodes of cough and wheezing are usually due to asthma, in both children and adults. Under-diagnosis of asthma is a frequent problem, especially in children who wheeze only with URIs. These children are often labeled as having bronchitis, bronchiolitis, Reactive Airway Disease (RAD) or pneumonia even though the signs/symptoms are most compatible with a diagnosis of asthma.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Differential diagnosis	NAEPP EPR-2 1997	C	1

E. (Box 7) Obtain Pre- and Post-Bronchodilator Baseline Spirometry

OBJECTIVE: All patients, if able, should perform pre- and post-bronchodilator spirometry during the initial assessment of asthma

ANNOTATION:

Baseline Spirometry:
- Discontinue short-acting bronchodilators at least six hours before testing
- Discontinue long acting beta$_2$-agonists at least 24 hours before testing
- Discontinue corticosteroids, leukotriene modifiers, cromolyn or nedocromil, and theophylline more than 2 days before testing, if possible

If spirometry is not available at the initial visit, then treat symptoms, and re-evaluate for diagnosis of asthma and reformulate treatment plan after obtaining spirometry at a later date. Spirometry should be obtained within 3 months of the initial visit in any patient suspected of having asthma.

DISCUSSION:

Spirometry detects the presence of airflow obstruction, defines the severity of airflow limitation, and aids in the differential diagnosis of asthma. When physical findings are not present, mild asthma may be detected by performing spirometry, especially with pre- and post-bronchodilator evaluation.

Spirometric measurements, before and after the inhalation of a short-acting beta$_2$-agonist, should be performed by patients in whom the diagnosis of asthma is being considered. Testing should be performed in compliance with ATS standards. Obstructive ventilatory defects can generally be determined using the forced expiratory volume in the first second (FEV_1), forced vital capacity (FVC) and FEV_1/FVC ratio. The use of PEF is less reliable secondary to its lack of reproducibility and dependency on patient effort. Please note that there is no single test sufficient or adequate to diagnose asthma.

Episodic Obstruction Patients with mild asthma, which is usually triggered by exercise, URIs, or environmental exposures, may have normal pulmonary function when asymptomatic, but repeated measurements of FEV_1 or PEF, particularly when symptomatic, may be useful in diagnosing these patients. Environmental triggers include exposure to aeroallergens, weather changes, tobacco smoke (passive or active), and cold air. The presence of wheezing may also indicate asthma.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
General guidelines and spirometry	NAEPP EPR-2 1997	C	1
Standardization of spirometry	American Thoracic Society (ATS) 1995	C	1
Clinical evaluation of asthma	Li et al. 1996	C	2a
Relation of pulmonary function tests to asthma	Enright et al. 1994	C	2a

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Use of PEF meters	Moscato et al. 1995	C	1
Asthma outcome related to pulmonary function	Enright et al. 1994 Quackenboss et al. 1991	C	2a

F. (Box 8) Airway Obstruction demonstrated by $FEV_1/FVC < 0.7$ (0.8 for children)

OBJECTIVE: To define airway obstruction

ANNOTATION: Airway obstruction is defined as a FEV_1/FVC ratio < 0.7 (0.8 for children)

DISCUSSION:

Obstructive defects are characterized by a disproportionate reduction in FEV_1 with respect to FVC. An FEV_1 less than 80% of the normal predicted value is also suggestive of airway obstruction. Airway obstruction may also result in a decrease in other expiratory flow rates, such as a mean mid-forced expiratory flow (FEF_{25-75}). An FEF_{25-75} which is < 50-60% of the normal predicted value is indicative of small airways obstruction.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Pulmonary function testing	ATS 1995	C	1
Asthma outcome related to pulmonary function	Enright et al. 1994	C	2a
Peak flow criteria	JTFPP 1995 Chernick & Boat 1998	B	2a

G. (Box 9) Is the Airway Obstruction Reversible?

OBJECTIVE: To define reversible airway obstruction

ANNOTATION:

Reversible airway obstruction is documented with improvement in $FEV_1 \geq 12\%$ (usually ≥ 200 ml in adults) or clinical improvement (improvement of symptoms during daytime, nighttime or exercise).

DISCUSSION:

Airway obstruction is considered reversible when FEV_1 has increased > 12% after administration of a $beta_2$-agonist. However, failure to demonstrate a change with bronchodilators does not exclude a reversible component of obstruction because airway inflammation may be present and not responsive to $beta_2$-agonists.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Interpretive strategies are useful in guiding therapy	ATS 1995 Enright et al. 1994	C	2a
Guideline for reversibility	ATS 1995 JTFPP 1995	C	1

H. (Box 10) Therapeutic Trial of Steroids

OBJECTIVE: To describe a therapeutic trial of corticosteroids when obstruction does not reverse with bronchodilators

ANNOTATION:

The patient should receive a trial of corticosteroids, either oral or inhaled, in addition to PRN $beta_2$-agonists:

- 1-2 weeks of a daily-administered oral corticosteroid in the following doses:
  - adults 40-60 mg/day
  - children 1-2mg/kg/day (maximum of 60 mg/day)
- 4-6 weeks of medium doses of inhaled corticosteroids

While oral corticosteroids are preferred for this diagnostic/therapeutic trial, it is also acceptable to conduct a 4-6 weeks trial using medium doses of an inhaled corticosteroid (see **Estimated Comparative Daily Dosages for Inhaled Corticosteroids Table** immediately below). An inhaled $beta_2$-agonist should be used prn for signs/symptoms of asthma.

TABLE: ESTIMATED COMPARATIVE DAILY DOSAGES FOR INHALED CORTICOSTEROIDS

Drug	Low-Dose	Medium-Dose	High-Dose
Beclomethasone dipropionate 42 mcg/puff 84 mcg/puff	168 to 504 mcg (4 to 12 puffs) (2 to 6 puffs)	504 to 840 mcg (12 to 20 puffs) (6-10 puffs)	> 840 mcg (> 20 puffs) (>10 puffs)
Budesonide Turbuhaler 200 mcg/dose	200-400 mcg (1-2 inhalations)	400-600 mcg (2-3 inhalations)	> 600 mcg (> 3 inhalations)
Flunisolide 250 mcg/puff	500-1,000 mcg (2 to 4 puffs)	1,000 to 2,000 mcg (4 to 8 puffs)	> 2,000 mcg (> 8 puffs)
Fluticasone MDI: 44, 110, 220 mcg/puff Dry powder inhaler (DPI): 50, 100, 250 mcg/puff	88-264 mcg	264-660 mcg	> 660 mcg
Triamcinolone acetonide 100 mcg/puff	400-1,000 mcg (4 to 10 puffs)	1,000-2,000 mcg (10 to 20 puffs)	> 2,000 mcg (> 20 puffs)

DISCUSSION:

Patients whose spirometric values indicate airway obstruction (FEV_1/FVC ratio < 0.7 [0.8 for children]) and who do not respond to bronchodilators (post-bronchodilators change in FEV_1 < 12%), should undergo a trial of corticosteroids. These patients may have airway obstruction with poor bronchodilator response. This is common in adult patients and older children with asthma. Many of these patients will have asthma, but there are several other common adult diseases that could cause this (e.g., chronic obstructive pulmonary disease [COPD]).

PEF is a simple, useful measure of airway obstruction that can be obtained using a relatively inexpensive peak flow monitor. The PEF readings may be helpful in assessing response to a therapeutic trial. Patients should record morning pre-bronchodilator PEF (NAEPP EPR-2 1997 recommendation) in a peak flow diary. Peak flow diaries include a description of asthma symptoms, medications used, and PEF readings. If after a trial of therapy a PEF value is ≥ 20% higher than the pre-trial PEF value, then this supports the diagnosis of asthma.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
General guidelines	NAEPP EPR-2 1997	C	1
Value of peak flow monitoring	Li 1995 D'Alonzo et al. 1995 Moscato et al. 1995	B	1
Oral and parenteral corticosteroids are useful in treating acute asthma exacerbations in children	Brunette et al. 1988 Tal et al. 1990 Weinberger 1988 Younger et al. 1987	B	1

I. (Box 12) Clinical Suspicion of Asthma Is High?

OBJECTIVE: To outline factors that should raise clinical suspicion of asthma despite normal spirometry

ANNOTATION:

Many patients with asthma, even some with symptoms, will have normal spirometry at the time of their initial clinic visit. Suspect asthma if any of the following is present:

- Wheezing and treatment with bronchodilators on more than one occasion in the past
- Wheezing noted at the time of the exam
- History of recurrent cough, especially nighttime cough, recurrent wheezing, or exercise intolerance with chest tightness/cough
- History of respiratory symptoms worsening with any of the following
  - Exercise
  - URIs
  - Exposure to aeroallergens
  - Weather changes
  - Tobacco smoke (passive or active)
  - Cold air
- Frequent colds with a lingering (> 2 weeks) cough which tends to worsen at night
- Chest tightness, wheeze, or cough which worsen at night
- A history of recurrent pneumonia

Further supporting evidence for asthma includes a family history of asthma, eczema, or allergic rhinitis.

If the clinical suspicion for asthma is high, then proceed to a therapeutic trial.

J. (Box 13) Trial of Inhaled Beta$_2$-Agonist

OBJECTIVE: To describe a therapeutic trial of short-acting beta$_2$-agonist in the patient who has normal pulmonary function tests (PFTs) and in whom one still strongly suspects asthma as the cause of the respiratory problem. Many children will fall into this category

ANNOTATION:

A therapeutic trial for patients with normal spirometry consists of an inhaled short-acting beta$_2$-agonist. Use PRN when symptomatic for 1-4 weeks (See albuterol in the **Medication Doses Table** at Module A3a, Annotation H).

DISCUSSION:

The beta$_2$-agonist should only be administered when the patient is symptomatic or before exercise or exposure to a known trigger. Observe for clinical improvement and also post-bronchodilator changes in PEF readings (when available). Patients with intermittent symptoms who are not symptomatic at the time of the initial clinic visit should return for another visit when they are symptomatic, as airway obstruction may be detected at that time.

TABLE OF EVIDENCE:

Intervention	Reference	Grade of Evidence	Strength of Recommendation
Trial of beta$_2$-agonist	NAEPP EPR-1 1991	C	1

K. (Box 14) Did Trial Result in Improved FEV_1 ≥12% or Clinical Improvement?

OBJECTIVE: To define positive response to therapeutic trial

ANNOTATION:

Improvement in PEF ≥ 20% or FEV_1 ≥ 12% (and 200 ml for adults), or clinical improvement (improvement of symptoms during daytime, nighttime or exercise [see Annotation G, this module]). Failure to demonstrate a change with bronchodilators does not exclude a reversible component of airway obstruction.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Brochodilator improvement	ATS 1995 NAEPP EPR-2 1997 JTFPP 1995	C	1

L. (Boxes 15 and 17) Consider Test for Airway Hyperresponsiveness With Appropriate Consultation

OBJECTIVE: To outline additional diagnostic options when the clinical suspicion of asthma remains high and a trial of short acting $beta_2$-agonists and corticosteroids has not been diagnostic

ANNOTATION:

The following tests can help diagnose asthma, though none are considered gold standards. Each test may measure different aspects of airway hyperresponsiveness. Therefore, severity of symptoms, level of clinical suspicion for asthma, and the patient's occupation should be considered when deciding upon which test to order.

- Bronchoprovocation testing (such as, methacholine, histamine, eucapnic hyperventilation, or cold air)
- Diurnal variation in PEF or variation of spirometry over time or with change of symptoms

DISCUSSION:

Bronchoprovocation testing should be performed per ATS standards and ordered in those patients with poorly defined triggers and normal baseline spirometry. Patients with these poorly defined symptoms should be considered for referral for specialty consultation prior to bronchoprovocation testing. However, primary care providers knowledgeable in the interpretation of the test results may order bronchoprovocation testing. **Note that bronchoprovocation testing is used less frequently in children.**

These studies should be performed in a pulmonary laboratory with expertise in bronchoprovocation testing.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Four different measures of bronchial responsiveness in asthmatic children	Sekerel 1997	B	1
A reduction in FEV_1 of 20 percent after bronchoprovocation indicates hyper-responsiveness	ATS 1995 Enright et al. 1994	C	2a
Bronchoprovocation testing	JTFPP 1995 NAEPP EPR-2 1997 Enright et al. 1994	C	2a

M. (Box 19) Assess Asthma Severity and Prescribe Medication Based on Table A (p. 63)

OBJECTIVE: To define the features sufficient to place a patient in a specific asthma severity category and to prescribe appropriate asthma medications

ANNOTATION:

The characteristics noted in **Table A** (p. 63) are general and may overlap because asthma is highly variable. Assign patients to the highest severity category in which they have any of the features. An individual's severity classification may change over time.

Patients at any level of severity can have mild, moderate, or severe exacerbations. Some patients with intermittent asthma may experience severe and life-threatening exacerbations separated by long periods of normal lung function and no symptoms.

At this point consider referral to an asthma specialist. Indications for referral to an asthma specialist (derived from NAEPP EPR-2 1997) include:

- Always refer patient with severe persistent asthma
  - Consider referral of patients with moderate persistent asthma
  - Patient with persistent asthma should be evaluated for allergies by either skin testing or in vitro testing (see discussion in Annotation O, this module)
  - Patient is unresponsive to therapy or is not meeting goals of therapy
  - Patient has a life-threatening asthma exacerbation
  - Problems in differential diagnosis
  - Other conditions complicating asthma: sinusitis, allergic bronchopulmonary aspergillosis, severe rhinitis, VCD, GERD
  - Additional testing indicated: skin testing, bronchoprovocation, complete pulmonary function studies, bronchoscopy
  - Patient requires additional education
  - Patient is being considered for immunotherapy
  - Patient requires continuous oral corticosteroids or more than 2 burst/taper treatments a year

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Assess severity	NAEPP EPR-2 1997	C	1

N. (Box 19) Identify Special Circumstances (Such as Pregnancy)

OBJECTIVE: To remind practitioner to consider pregnancy and other physiologic conditions that might affect asthma care

ANNOTATION:

Pregnancy

- The condition of pregnancy does not alter the therapeutic goals of asthma management
- Often only slight medication modifications are needed
- Health care providers who are unfamiliar with the management of asthma in pregnancy are referred to the NAEPP EPR-2 1997 Management of Asthma During Pregnancy. Alternatively, the patient should be referred to a provider with experience in treating asthma during pregnancy, or the patient should be co-managed closely by the providers of her obstetric and pulmonary care

Physiologic Conditions

- Surgery (perioperative period)
- Geriatric conditions

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Management of asthma during pregnancy	NAEPP EPR-2 1997	C	2a
Management of asthma in the elderly	NAEPP WGR 1996	C	2a
Guide for the diagnosis and treatment of asthma	NAEPP EPR-2 1997	C	1

O. (Box 20) Evaluate for Triggers and Develop Plan to Minimize Environmental Triggers

OBJECTIVE: To provide a plan for evaluation of triggers and control of environmental factors

ANNOTATION:

- Obtain a detailed history of triggers to include:
  - Irritants and allergens
  - Occupational exposures
  - Consider increased exposure to viral pathogens (e.g., day care)
- Allergy testing (skin prick or radioimmunoallergo sorbent test [RAST] tests)
  - Should be directed at allergens to which the patient is exposed
  - Limited use in the elderly
  - Interpretation must include clinical correlation
  - Food allergies rarely trigger asthma
  - RAST or skin testing with large numbers of allergies is rarely indicated

DISCUSSION:

A comprehensive allergy trigger history is often difficult to obtain. Factors limiting history include the time required to answer questions, difficulty remembering past exposures, and multiple locations where exposures may have occurred. The use of tools such as a questionnaire that the patient and family can complete at home before the follow-up visit is encouraged. Examples of screening tools are provided in the NAEPP EPR-2 guidelines.

The association of asthma and allergy has long been recognized. Recent studies confirm that sensitization to indoor allergens such as house dust mite, animal dander, and cockroach or to the outdoor fungus Alternaria is a risk for developing asthma. Sensitization to outdoor pollens carries less risk for asthma, although grass and ragweed pollen exposures have been associated with seasonal asthma.

An allergic reaction in the airways caused by natural exposure to allergens leads to increases in airway inflammation, airway hyperresponsiveness, and pulmonary eosinophils. Research has demonstrated that asthma symptoms, pulmonary function, and need for medication in asthma patients sensitized to dust mites correlate with the level of house dust mite exposure. Reducing house dust mite exposure decreases asthma symptoms, nonspecific bronchial hyperresponsiveness, and airway inflammation. These reports emphasize that allergen exposure must be considered in the treatment of asthma. Aeroallergens, and not food allergens, are the most important allergens.

Determination of sensitivity to a perennial indoor allergen usually cannot be accomplished with medical history alone. Increased symptoms during vacuuming or bed-making and decreased symptoms when away from home are suggestive but not sufficient. Skin testing, and in vitro tests, e.g. RAST, are reliable in determining the presence of specific IgE, but these tests do not determine whether the specific IgE is responsible for the patient's symptoms. Patients should only be tested for sensitivity to the allergens to which they are exposed.

Skin or in vitro tests for patients exposed to perennial allergens can be useful to determine allergy. They are essential to justify the expense and effort involved in implementing environmental controls. In addition, patient adherence to maintaining environmental controls (e.g., with regard to pets) is likely to be poor without proof of the patient's sensitivity. Large panels of indiscriminate allergen specific IgE measurements, whether by *in vitro* RAST testing or *in vivo* skin testing, may result in unnecessary costs and/or test-related morbidity.

TABLE OF EVIDENCE:

Intervention	Reference	Grade of Evidence	Strength of Recommendation
The strong association between sensitization to allergens and asthma	Peat et al. 1993, 1994 Sporik et al. 1990 Sears et al. 1989 Reid et al. 1986 Creticos et al. 1996 Pollart et al. 1989 Rak et al. 1991 Vervloet et al. 1991 Zock et al. 1994 Peroni et al. 1994 Piacentini et al. 1993 Simon et al. 1994 Targonski et al. 1995 O'Hollaren et al. 1991 Call et al. 1994 Golbert et al. 1969 Sampson et al. 1992 James et al. 1994	A	1
Rationale for allergy testing for perennial indoor allergens	Murray and Milner 1995 Adinoff et al. 1990 Taylor and Newacheck 1992 Boston Consulting Group 1992 Nelson and Fernandez-Caldas 1995 Ingram et al. 1995	B	1
Allergy tests in the elderly	Braman et al. 1991 NAEPP WGR 1996	C	2a

P. (Box 20) Provide Patient Education, Written Action Plans and Objective Monitoring (FEV_1 or PEF)

OBJECTIVE: To emphasize patient asthma education, written Action Plans, and objective monitoring (FEV_1 or PEF)

ANNOTATION:

Patient education is essential for the successful management of asthma. Patient education should start at the first visit.

- Critical education elements which should be assessed at every office visit:
  - Proper demonstration of inhaler and spacer/holding chamber technique
  - A written Asthma Action Plan should be developed
  - Asthma education in collaboration with other health care professionals
- Additional education elements may include:
  - Understanding basic pathophysiology of asthma
  - Medications (therapeutic mechanism, indications and adverse effects)
  - Early recognition and prompt treatment of asthma exacerbations
  - Avoidance or control of important triggers

Asthma Action Plan All patients should have a written Asthma Action Plan. Essential components of the Action Plan include current medications and dosages, warning signs/symptoms of impending exacerbations, PEF measurements, instructions for use of asthma medications during exacerbations, and instructions (including telephone numbers) for when and whom to call.

Education and Asthma Action Plan elements include:
- Medication management
- Environmental management
- Asthma exacerbation management
- Chronic management
- School/day care (children)
- Monitoring Your Asthma

Objective Monitoring
- PEF monitoring should be done periodically and at times of exacerbations
- The preferred diagnostic test for asthma is spirometry
- Daily home PEF monitoring/diary may be useful for patients with persistent asthma
- Laboratory and radiologic testing as indicated

DISCUSSION:

For patients with persistent asthma, home diaries that include symptoms, actions taken, medications used, outcomes, and PEF readings may be useful. Daily home monitoring of PEF for patients with intermittent asthma has not been shown to be useful. Frequent re-education of use of PEF is required to ensure proper technique and good adherence.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
General guidelines	NAEPP EPR-2 1997	C	1
Patient education and self-management plan improves outcome in asthma	Wilson et al. 1993 Trautner et al. 1993 Olsen 1991 Bailey et al. 1990	A	1
Peak flow monitoring is effective in improving management of asthma	Woolcock et al. 1988 Ignacio-Garcia et al. 1995 Lahdensuo et al. 1996 Feder et al. 1995 Parker 1989 Beasley et al. 1989	A	1
Environmental control can reduce bronchial reactivity	Platts-Mills et al. 1982	C	2a
Immunotherapy is effective in selected patients with allergic asthma	Abramson et al. 1995	A	1

Q. (Box 21) Schedule Follow-Up Visit

OBJECTIVE: To provide recommendations for follow-up evaluation of patients both while the diagnosis of asthma is being considered and after the initial diagnosis is made

ANNOTATION:

General recommendations:
- Maximize continuity of care in the evaluation process preferentially with the patient's provider/primary care manager (PCM)

- Consider weekly or bimonthly visits until asthma or an alternative cause has been diagnosed
- Patient's severity should ultimately dictate frequency of follow-up
- Consider follow-up after initial diagnosis within 2-4 weeks

DISCUSSION:

It is recognized that the steps of this algorithm and/or the diagnosis of asthma may not be completed in a single visit. Additionally, the optimal time course for establishing the diagnosis or following up a newly diagnosed asthmatic has not been determined.

It is recommended that every effort be made to expedite the evaluation and diagnosis so that appropriate treatment may begin. After the initial diagnosis is made, several visits may be required to ensure appropriate education and medical adherence.

Asthma Treatment Follow-Up Management for Adults and Children Age 6 Years and Over (A2a)

A. (Box 2) Is There Evidence of an Acute Asthma Exacerbation?

OBJECTIVE: To recognize signs/symptoms of acute asthma exacerbation

ANNOTATION:

The quickest way to assess asthma severity is to evaluate respiratory status and patient comfort level.

- Common signs/symptoms of acute asthma are shortness of breath, chest tightness, cough, and wheezing.
- Other symptoms are anxiety, inability to lie down comfortably or sleep due to dyspnea.
- Signs/symptoms may start abruptly or be progressive over hours to days.
- Signs of acute, severe asthma are tachypnea, tachycardia, pulsus paradoxus, accessory respiratory muscle use, prolonged expiratory phase, hyperinflation of chest, appearance of anxiety, inability to speak in full sentences (age-dependent), cyanosis, and confusion or lethargy.
- The prominence of wheezing may not correlate with the severity of the asthma exacerbation. Decreased wheezing may actually indicate worsening asthma and impending respiratory failure.
- Triggers of asthma exacerbations: upper respiratory infections (URIs), allergen exposure, exercise, toxic fume inhalation, tobacco smoke, and breathing cold or dry air.
- A history of previous frequent hospitalizations (especially to an ICU), previous need for mechanical ventilation for asthma, recent emergency department (ED) visits, and a history of prolonged, severe asthma are all risk factors for severe asthma exacerbations which may result in hospitalization.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Clinical assessment of asthma	Corbridge 1995 Lowenthal 1993	C	2a
Risk factors for fatal asthma	Strunk 1989	B	1

B. (Box 4) Perform Interim History and Physical Exam

OBJECTIVE: To highlight the important aspects of the interim history and physician examination

ANNOTATION:

A good interim history should include the following:

- Signs/symptoms of asthma
- Hospitalizations (ICU/intubations) and Emergency Department (ED) visits
- Missed school or work days
- Triggers
- Home Peak Expiratory Flow (PEF) values
- Daily peak flow monitoring should include at least a PEF on waking from sleep in the morning before taking a bronchodilator
- Identification of the characteristics of patient's typical exacerbation
- Comorbidities
- Aggravating factors
  - URIs
  - Aeroallergens
  - Exercise
  - Irritants (tobacco smoke, perfume, etc.)
- Drugs (ASA, beta blockers)
- Medication adherence
- Medication adverse effect

A focused physical examination should concentrate on the following areas:
- Nose and throat
- Chest exam
- All patients receiving oral corticosteroids should have blood pressure checks at every asthma clinic visit
- All children receiving long-term inhaled or systemic corticosteroids should have heights measured with a stadiometer and plotted on a standard growth curve at each clinic visit for asthma

DISCUSSION:

The purpose of periodic assessment and ongoing monitoring is to assure that the goals of asthma therapy are being achieved. Ongoing monitoring in the 5 areas listed below is encouraged.

1. Every patient with asthma should be taught to recognize symptom patterns that indicate inadequate asthma control. Symptoms and clinical signs of asthma should be assessed at each healthcare visit.
2. It is crucial to determine how asthma is affecting the patient's quality of life. A variety of comprehensive survey instruments (e.g., Juniper Scale) have been developed to assess functional status.
3. Monitoring of exacerbations is important. Ask about precipitating exposures and triggers, unscheduled visits or calls for advice. Control can be assessed by need for oral corticosteroids and rescue short-acting $beta_2$-agonists.
4. Pharmacotherapy assessment to include addressing adherence, inhaler and spacer/holding chamber technique, changes in medication dosage, use of rescue medications, and adverse effects. It is also critical that the clinician ensures that the patient is on the correct step level of pharmacotherapy and has an up-to-date written daily self-management and Action Plan.
5. Healthcare providers need to regularly assess the effectiveness of patient-provider communication. Unrestricted communication between the clinician, patient, and family is essential to ensure successful self-management. Easy telephone access is important.

TABLE OF EVIDENCE:

Intervention	Reference	Grade of Evidence	Strength of Recommendation
Important features of the history and physical exam	NAEPP EPR-2 1997	C	2a

C. (Box 5) Assess and Classify Asthma Severity Using Table A (p. 63)

OBJECTIVE: To define the features sufficient to classify a patient in an asthma severity category

ANNOTATION:

Assign patients to the highest asthma severity category in which they have any of the features. The characteristics noted in **Table A** (p. 63) are general and may overlap because asthma is highly variable. An individual's severity classification may change over time.

Patients at any level of severity can have a mild, moderate, or severe exacerbation. Some patients with intermittent asthma may experience severe and life-threatening exacerbations separated by long periods of normal lung function and no symptoms.

TABLE OF EVIDENCE:

Intervention	Reference	Grade of Evidence	Strength of Recommendation
Asthma severity classification	NAEPP EPR-2 1997	C	2a

D. (Box 5) Identify Special Circumstances (Such as Pregnancy)

OBJECTIVE: To remind practitioner to consider pregnancy and other physiologic conditions that might affect asthma care

ANNOTATION:

Pregnancy:
- The condition of pregnancy does not alter the therapeutic goals of asthma management
- Often only slight medication modifications are needed
- Health care providers who are unfamiliar with the management of asthma in pregnancy are referred to the NAEPP EPR-2 1997 Management of Asthma During Pregnancy. Alternatively, the patient should be referred to a provider with experience in treating asthma during pregnancy, or the patient should be co-managed closely by the providers of her obstetric and respiratory care

Physiologic Conditions:
- Surgery (perioperative period)
- Geriatric conditions

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Management of asthma during pregnancy	NAEPP EPR-2 1997	C	2a
Management of asthma in the elderly	NAEPP WGR 1996	C	2a
Guide for the diagnosis and treatment of asthma	NAEPP EPR-2 1997	C	1

E. (Box 6) Are There Comorbid Conditions Affecting Asthma Control?

OBJECTIVE: To identify medical conditions that can aggravate asthma

ANNOTATION:

Co-morbid conditions which can aggravate asthma:
- Allergic rhinitis
- Sinusitis
- Gastroesophageal reflux disorder (GERD)
- Vocal cord dysfunction (VCD)
- Tobacco abuse
- Aspirin sensitivity
- Allergic bronchopulmonary aspergillosis (ABPA)

DISCUSSION:

Undertreated allergic rhinitis and/or subacute/chronic sinusitis can exacerbate asthma. The diagnosis of either of these disorders should be considered in anyone with asthma and upper respiratory tract symptoms. Many children with asthma have concomitant allergic rhinitis and are at risk for rhinosinusitis.

GERD may be difficult to diagnose. Silent GERD can result in lower airway inflammation or may exacerbate pre-existing airway inflammation. The absence of heartburn, chest pain, or acid-taste in the mouth do not eliminate the possibility of GERD. Subtle symptoms may include unexplained irritability, foul smelling breath, cough worse with sleep or recumbency, and difficult-to-control asthma.

VCD is most common in adolescents and young adults. Up to 25% of patients with VCD have asthma. A diagnosis of VCD should be considered if the patient has inspiratory difficulty, stridor, and a normal SaO_2 while breathing room air despite significant respiratory distress.

ABPA can complicate asthma. It is a hypersensitivity reaction to one of several common environmental fungi. The most common is Aspergillus fumigatus, however several other fungal agents have been reported to cause this disorder.

TABLE OF EVIDENCE:

Comorbidity	References	Grade of Evidence	Strength of Recommendation
Rhinosinusitis	Wald 1995 Friday and Fireman 1988	C	2a
GERD	Balson et al. 1998 Orenstein 1991 Eid et al. 1994 Orenstein 1988	C	2a
VCD	Newman et al. 1994 Newman et al. 1995	C	2a
ABPA	Greenberger 1988	C	2a

F. (Box 6) Are There Medication Effects Affecting Asthma Control?

OBJECTIVE: To identify common adverse effects of medications

ANNOTATION: **ADVERSE EFFECTS OF DRUGS TABLE**

Drug	Adverse Effects
Corticosteroids A. Inhaled: • Beclomethasone • Budesonide • Flunisolide • Fluticasone propionate • Triamcinolone acetonide	Cough, dysphonia, oral thrush (candidiasis). In high doses, systemic effects may occur
B. Systemic: • Methylprednisolone • Prednisolone • Prednisone	Short-term use: – Hyperglycemia – Increased appetite – Personality changes – Fluid retention – Weight gain – Hypertension – Peptic Ulcer Disease – Aseptic necrosis of the femoral head Long-term use: – Adrenal axis suppression – Growth suppression – Dermal thinning – Hypertension – Diabetes mellitus – Cushing's syndrome – Cataracts – Muscle weakness – Impaired immune function
Cromolyn and Nedocromil	– Cough – Unpleasant taste – Bronchospasm – Lactose intolerance – Nasal congestion – Nausea – Irritation of throat
Methylxanthines • Theophylline	– Insomnia – Gastrointestinal upset – Hyperglycemia – Hypokalemia – Aggravation of GERD – Overdose-tachycardia, nausea & vomiting, tachyarrhythmias, central nervous stimulation, headache, seizures
Short acting Beta$_2$-Agonists • Albuterol • Metaproterenol	– Headache – Tachycardia – Skeletal muscle tremor – Hypokalemia – Hyperglycemia
Anticholinergics-Inhaled • Ipratropium	– Dry mouth – Increased wheezing – Blurred vision if introduced into eyes
Epinephrine	– Convulsions – Chills – Fever – Hallucinations – Cardiovascular Stimulation – Skeletal muscle tremor

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Adverse effects of asthma medications	NAEPP EPR-2 1997 Horowitz 1998	C	1
Inhaled corticosteroids and growth	Merkus et al. 1993 Konig et al. 1993 Doull et al. 1995 Allen et al. 1998 Efthimiou et al. 1998	C	1

G. (Box 8) Are There Problems With Patient Adherence/Inhaler Technique?

OBJECTIVE: To assure that medication is taken as prescribed using proper technique

ANNOTATION:

- MDIs are most effective when used in conjunction with a spacer/holding chamber
- Reassess both proper MDI and spacer/holding chamber technique at every visit
- If using a nebulizer, review proper technique at every visit

Compliance with long-term inhaled medications is typically low (approximately 50%).

DISCUSSION:

Having established that the patient understands and can perform skills in the care plan, the next key question is: “Is the patient following it?" Understanding does not equate to adherence. Patients may be unwilling to admit that they have not been following prescribed treatment. Determine which elements of the care plan, if any, are not being followed, and ask the patients why they are not following them.

Activities and questions that help to determine the level of patient adherence include: reviewing the symptom diary, medication use and prescription refill patterns. In addition, it is important to identify the parts of the treatment plan that are most difficult to perform and the changes which might make it easier to carry out. Identify the parts of the treatment plan that work best.

TABLE: MEDICATION MANAGEMENT PLAN

ASSESSMENT QUESTIONS	INFORMATION	EXPECTED SKILLS AND KNOWLEDGE	REFERRALS
Do you understand why you are prescribed these medicines?	The written medication management plan identifies the name for each ordered medication (generic and trade).	The patient identifies each medication used and states the action for each drug.	
What does each drug do?	Action of drug and its importance		
What is the dose and frequency for each drug?	Dose and frequency	Identifies dose and frequency for each drug	
What are the undesirable adverse effects with each of these drugs?	Potential adverse effects, possible interactions What to do if there is an adverse effect	Describes possible adverse effects for each drug. Knows who to call or what to do when there is an adverse effect.	
Which drug is your controller and which is your reliever?	1. **Controller or Preventer** medicines – anti-inflammatory agents and steroids: Effects not immediately apparent but are the most important in treating the underlying inflammation of the airway in asthma.	Differentiates controller from reliever.	Asthma educator to supplement or provide teaching elements
Why should you only take relievers when you have worsening of difficult breathing?	2. **Relievers** - Drugs which relieve symptoms (bronchodilators)	Differentiates fast reliever from slow reliever and knows the importance of using each as directed.	
Why do you only take your salmeterol twice daily?	Differentiate fast relievers (fast onset, short acting) (e.g., albuterol) from slow relievers (slow onset, long acting) (e.g., salmeterol).	States that salmeterol does not take effect in a short time but lasts a long time.	

H. (Box 10) Environmental Triggers Identified?

OBJECTIVE: To identify important environmental triggers

ANNOTATION:

The following are important environmental triggers:

- Exposure to aeroallergens
  - Pollen
  - Dust mites
  - Animal danders
  - Molds
  - Occupational exposures
- Weather changes
- Tobacco smoke (passive or active)
- Cold air
- Air pollution
- Smoke from wood-burning stoves

Measures to identify allergens:
- Allergy history alone may not be sufficient to identify whether a patient has significant allergies
- Consider skin or RAST testing for patients with mild persistent asthma
- Skin test or RAST is recommended for patients with moderate or severe persistent asthma

DISCUSSION:

Rationale for Allergy Testing for Perennial Indoor Allergens The determination of sensitivity to perennial indoor allergens is usually not possible with medical history alone. Increased symptoms during vacuuming or bed making and decreased symptoms when away from home are suggestive but not sufficient to identify dust mite sensitive patients. Allergy skin or in vitro RAST tests are reliable in determining the presence of specific IgE, but these tests do not determine whether the specific IgE is responsible for the patient's symptoms.

It is recommended that patients with persistent asthma be tested for aeroallergens with either RAST or skin tests. This recommendation will result in approximately half of all children with asthma being tested. It is estimated that about half of all asthma patients have persistent asthma based on data on children in the United States and on adults in Australia. Approximately 80% of the U.S. population is exposed to house dust mites, 60% to cat or dog, and a much smaller percentage to both animals. Cockroach sensitization is a consideration primarily in the inner city and southern parts of the United States.

Skin or in vitro testing for patients exposed to perennial allergens is essential to justify the expense and effort involved in implementing environmental controls. Patient adherence to maintaining environmental controls (e.g., with regard to pets) is likely to be poor without proof of the patient's sensitivity to allergens. In addition, large panels of indiscriminate allergen specific IgE measurements, whether by in vitro RAST testing or in vivo skin testing, may result in unnecessary costs and/or test-related morbidity.

RAST Testing In vitro testing for individual allergen specific IgE (RAST) can be used, in conjunction with detailed environmental and trigger history, to identify allergen sensitization and the need for specific environmental controls and immunotherapy. However, RAST tests are NOT as sensitive as skin testing and have a number of pitfalls or abuses. These include the provider ordering too many allergens to be tested for or failing to select a laboratory with adequate quality control and standardization practices (resulting in potentially higher rates of false positive and false negative rates).

Advantages of Skin Testing:
- Less expensive than in vitro tests
- Results are available within one hour
- More sensitive than in vitro tests
- Results are visible to the patient which may encourage adherence to environmental control measures

Advantages of RAST and other in vitro tests:
- Do not require knowledge of skin testing technique
- Do not require availability of allergen extracts
- Can be performed on patients who are taking medications that suppress the immediate skin test (antihistamines)
- No risk of systemic reactions
- Can be done on patients with extensive eczema

Allergy Tests in the Elderly Allergy skin tests or studies of specific IgE need not be routinely performed because allergens seem to play a less important role for elderly patients than younger patients and a less important role in those who develop asthma after age 65. If there is a history of allergic rhinitis, or of asthma-like response to aeroallergens, and the response seems to disappear with allergen avoidance, confirming documentation with skin tests and specific IgE studies may be appropriate. Indoor allergens (dust mite, animal danders, and molds) may be more important to evaluate than outdoor allergens; the specific tests will vary by geographic region.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Weather changes and asthma	Celenza et al. 1996 Newson et al. 1998	B	2a
Allergy history does not accurately predict positive allergy tests	Murray and Milner 1995	B	1
RAST and skin tests can reliably predict the presence of allergen specific IgE	Adinoff et al. 1990	B	1
Prevalence of asthma in children	Taylor and Newacheck 1992	B	1
Prevalence of asthma in adults	Boston Consulting Group 1992	B	1
Frequent exposure to common aeroallergens	Nelson and Fernandez-Caldas 1995 Ingram et al. 1995	B	1
Considerations for diagnosing and managing asthma in the elderly	NAEPP Working Group Report 1996 Braman et al. 1991	C	2a
RAST vs. skin testing	van der Zee et al. 1988 Matsson 1998	B	2a
Relationship between food-specific IgE concentrations and the risk of positive food challenges in children and adolescents	Sampson and Ho 1997	C	2a
Tools for allergy screening	NAEPP EPR-2 1997	C	2a
The strong association between asthma and allergy	Reid et al. 1986 Peat et al. 1993 Creticos et al. 1996	A	1
Allergies play a less important role in children < 4 years old	Wilson 1992 Duff 1993	B	2a
Allergy history does not accurately predict positive allergy tests	Murray and Milner et al. 1995	B	1
RAST vs. skin testing	Adinson et al. 1980 Van der Zee et al. 1988 Matsson 1998	B	2a
RAST and skin tests can reliably predict the presence of allergen specific IgE	Adinoff et al. 1990	B	1
Prevalence of asthma in children	Taylor and Newacheck 1992	B	1
Frequent exposure to common aeroallergens	Nelson & Fernandez-Calders 1995 Ingram et al. 1995	B	1
Weather changes and asthma	Celenza et al. 1996 Newson et al. 1998	B	2a

I. (Box 11) Develop Plan to Minimize Environmental Triggers

OBJECTIVE: To identify measures to minimize environmental exposure to triggers

ANNOTATION:

- Identify allergic triggers by in vitro or in vivo diagnosis of allergens when indicated
- Use dust mite avoidance measures for dust mite allergic patients:
  - Primary measures
    - Encase mattress in an allergen-impermeable cover
    - Encase pillow in an allergen-impermeable cover or wash it weekly
    - Wash sheets and blankets on the patient's bed in hot water weekly (Send sheets out or turn water temperature up to > 130° F, the temperature necessary for killing mites. Since this is a potential burn risk in households with children, usually keep water temperature < 120° to protect children)
  - Secondary measures
    - Reduce indoor humidity to less than 50 percent
    - Remove carpets from the bedroom
    - Avoid sleeping or lying on upholstered furniture
    - In children's bedrooms, minimize the number of stuffed toys and wash the toys weekly in hot water.
- Pet avoidance: If sensitization has been documented then remove animals from house or, at a minimum, keep animals out of patient's bedroom and cover (with a filter) the air ducts that lead to bedroom.
- Indoor mold prevention:
  - Fix all leaks and eliminate water sources associated with mold growth
  - Clean moldy surfaces
  - Consider reducing indoor humidity to less than 50 percent
- To avoid exposures to pollens (trees, grass, weeds)
  - Stay indoors with windows closed and air-conditioning/air cleaner turned on during the season that the patient is having problems with outdoor allergens, especially during the afternoon.
- Indoor/Outdoor Pollutants and Irritants
  - Avoid wood-burning stoves or fireplaces
  - Avoid poorly vented stoves or heaters
  - Avoid other irritants (e.g., perfumes, cleaning agents, sprays)

DISCUSSION:

Allergen immunotherapy (AIT) may be considered for selected asthma patients when:
- There is clear evidence of a relationship between symptoms and exposure to an unavoidable allergen to which the patient is sensitive.
- Symptoms occur all year or during a major portion of the year.
- There is difficulty controlling symptoms with pharmacologic management either because the medication is ineffective, multiple medications are required, or the patient is not accepting of medication.
- Chronic medication use interferes with the patient's occupation or is poorly complied with due to other factors that cannot be modified.
- In active duty military personnel who develop new onset asthma symptoms after induction. Maintenance, allergen-specific immunotherapy may induce a remission of symptoms and a return to normal physical activity without oral or inhalant medication.

This recommendation is based on the NAEPP EPR-2 1997. If AIT is prescribed, it should be administered only in a physician's office where facilities and trained personnel are available to treat any life-threatening reaction caused by immunotherapy.

Controlled studies of immunotherapy, usually conducted with single allergens, have demonstrated reduction in asthma symptoms caused by exposure to grass, cat, house dust mite, ragweed, Cladosporium, and Alternaria. A meta-analysis of 20 randomized, placebo-controlled studies has confirmed the effectiveness of immunotherapy in some patients with asthma.

The course of AIT is typically of 3 to 5 years in duration. However, many patients with an excellent response to AIT require continued therapy for more than seven years. Reactions to immunotherapy, especially bronchoconstriction, are more frequent among patients with asthma, particularly those with poorly controlled asthma, compared with those with allergic rhinitis alone. For this reason, recommendations for the use of immunotherapy differs considerably among experts.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Allergen immunotherapy: therapeutic vaccines for allergic diseases	NHBLI 1998	A	1
Allergen avoidance or control measures	Woodfolk et al. 1995 Kang et al. 1993 Call et al. 1992 Rosenstreich et al. 1997 Cuijpers et al. 1995 Verhoeff et al. 1995 Bjornsson et al. 1995 Smedje et al. 1996 Strachan 1988 Solomon et al. 1980 Long and Kramer 1972 Smith and Rooks 1954 Mullins et al. 1986 Reid et al. 1986 Malling et al. 1986 Creticos et al. 1996 Horst et al. 1990 Abramson et al. 1995 Reid et al. 1993 Abramson et al. 1995 Canadian Society of Allergy and Clinical Immunology 1995 Frew 1993	A	1

J. (Box 12) Are Symptoms Controlled and is Pulmonary Function Normal or Optimal for Patient?

OBJECTIVE: To determine whether a patient's asthma is controlled

Criteria for good control:

- Patients with **Mild Asthma Severity**: Normal activity level and normal home PEF. Ability to sleep through the night without waking with asthma symptoms. Need for PRN beta$_2$-agonist less than twice a week
- Patients with **Moderate Asthma Severity**: Normal activity level, reduced PEF variability. Infrequent nocturnal symptoms, infrequent exacerbations, and reduced frequency of PRN-inhaled beta$_2$-agonists (less than twice a day)
- Patients with **Severe Asthma Severity**: Near normal activity level, reduced PEF variability. Improved pulmonary function, infrequent awakening at night, reduced frequency of PRN-inhaled beta$_2$-agonist, reduced need for corticosteroid burst, and reduced need for emergency department treatment

K. (Box 13) Consider Medication Step-Down

OBJECTIVE: Instruction on medication step-down

ANNOTATION:

- For patients whose asthma is well controlled, consider step-down therapy.
- Patients should be followed closely as their symptoms may increase with medication step-down.
- For inhaled steroids (moderate-high dose), consider decreasing dosage by no more than 25% every 2-3 months.

L. (Box 14) Consider Medication Step-Up (See **Table A**, p. 63)

OBJECTIVE: To instruct on increasing medications based on current asthma severity level and control. Also to provide instruction on when to refer to an asthma specialist

ANNOTATION:

Reclassify patient's asthma severity, consider an alternative diagnosis, and consider a comorbid process. This might be an appropriate time for referral of the patient to the next higher level of care, such as an asthma specialist. For guidelines on the pharmacologic management of asthma using the step classification system, see **Table A** (p. 63).

Indications for referral to asthma specialist (derived from NAEPP EPR-2 1997:
- Always refer patient with severe persistent asthma
- Consider referral for moderate persistent asthma
- Patient with persistent asthma should be evaluated for allergies by either skin testing or in vitro testing (See discussion in Annotation H, this module)
- Patient is unresponsive to therapy or is not meeting goals of therapy
- Patients who have had life-threatening asthma exacerbations
- Problems in differential diagnosis
- Other conditions complicating asthma: sinusitis, aspergillosis, severe allergic rhinitis, vocal cord dysfunction, GERD
- Additional testing indicated: skin testing, bronchoprovocation, complete pulmonary function studies, bronchoscopy
- Patient requires additional education
- Patient is being considered for immunotherapy
- Patient requires continuous oral corticosteroids or more than two burst/taper treatments a year

M. (Box 15) Provide and/or Review and Update Patient Education and Written Action Plans

OBJECTIVE: To ensure that every patient has an up-to-date Asthma Education Plan and a written Action Plan, including objective monitoring

ANNOTATION:

Patient education is essential for successful management of asthma. Patient education should continue from the first visit.

Important education elements:
- Proper demonstration of inhaler and spacer/holding chamber technique
- A written Asthma Action Plan should be developed.
- Understanding basic pathophysiology of asthma
- Medications (therapeutic mechanism, indications and adverse effects)
- Early recognition and prompt treatment of asthma exacerbations
- Avoidance or control of important triggers

Asthma Action Plan: Each patient should have a written asthma Action Plan. Essential components include current medications and dosages; warning signs/symptoms of impending exacerbations; PEF measurements; instructions for use of asthma medications during exacerbations; and instructions (including telephone numbers) for when and whom to call.

Action Plan elements include:
- Medication management
- Environmental management
- Acute episode management
- Chronic management
- School/day care (children)
- Monitoring Your Asthma

Objective monitoring at home:
- PEF monitoring should be done periodically and at times of exacerbations.
- Daily home PEF monitoring/diary may be useful for patients with persistent asthma.

DISCUSSION:

For patients with persistent asthma, diaries should be maintained which include symptoms, actions taken, medications used, outcomes and the PEF measurement. Daily home monitoring of PEF for patients with intermittent asthma has not been shown to be useful. Frequent re-education on the use of the PEF is required.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
General guidelines	NAEPP EPR-2 1997	C	2a
Patient education and self management plan improves outcome in asthma	Wilson et al. 1993 Trautner et al. 1993 Bailey et al. 1990	A	1
Peak flow monitoring is effective in improving management of asthma	Woolcock et al. 1988 Ignacio-Garcia et al. 1995 Lahdensuo et al. 1996 Feder et al. 1995 Parker 1989 Beasley et al. 1989	A	1
Environmental control can reduce bronchial reactivity	Platts-Mills et al. 1982	C	2a
Immunotherapy is effective in selected patients with allergic asthma	Abramson et al. 1995	A	1

N. (Box 16) Preventive Health Maintenance

OBJECTIVE: To review the appropriate preventive health services for patients with asthma

ANNOTATION:

Patients should receive:
- Annual influenza vaccination for patients with persistent asthma
- Pneumovax vaccination (once in lifetime) for adults with persistent asthma
- Asthma education
- Height measurements in children on a regular basis for those taking inhaled or oral corticosteroid therapy

Upon initiation of oral chronic corticosteroid therapy, adult patients should receive the following care to limit the harmful effects on bone mineral density:
- Counseling on the importance of weight bearing exercise, smoking cessation, and abstinence of alcohol for bone preservation
- Screening for secondary causes of osteoporosis
- Baseline dual energy x-ray absorptiometry (DEXA) scan of the anteroposterior (AP) lumbar spine and femoral neck with repeat scan in 6-12 months
- Serum and 24-hour urinary calcium at baseline, 1 month, then routinely
- Unless contraindicated, the following chemoprophylaxis can be initiated at the first visit:
  - 1500 mg per day of calcium supplements
  - Vitamin D supplementation
  - Estrogen replacement therapy in postmenopausal women (testosterone replacement is recommended for all hypogonadal men)

Patients receiving long-term oral corticosteroid therapy should receive routine:
- Annual eye exams for cataracts
- Blood pressure measurements
- Fasting blood glucose measurements

Patients receiving long-term oral corticosteroid therapy should NOT receive vaccinations with varicella, oral polio vaccine (OPV), or measles.

All patients who use tobacco should receive counseling on tobacco cessation with adjunctive pharmacotherapy to promote quitting, e.g., nicotine replacement therapy (See VHA/DoD CPG on Tobacco Use Cessation).

DISCUSSION:

All patients with persistent asthma should receive the vaccination for influenza annually.

All patients requiring oral steroid therapy should be counseled on possible adverse effects including osteoporosis, diabetes, cataract formation, myopathy, suppression of hypothalamic-pituitary adrenal axis, weight gain, and fluid retention.

It is well established that long-term use of supraphysiologic doses of glucocorticoids (> 7.5mg/day) is associated with increased cortical and trabecular bone loss and risk of fracture. The multifactorial process involves decreased gastrointestinal absorption, increased renal excretion, decreased androgen release, and inhibition of osteoblastic activity. Preventive strategies should be initiated as soon as possible since the most rapid bone loss occurs in the first six months of therapy.

Patients initiating long-term glucocorticoid therapy should be screened for treatable causes of osteoporosis. Common secondary causes of osteoporosis include alcohol or tobacco use, hypogonadism, hyperthyroidism, hyperparathyroidism, osteomalacia, renal osteodystrophy, and multiple myeloma. Appropriate tests should be ordered to evaluate and treat these causes as indicated.

Quantitative computed tomography (QCT) and DEXA scans have been used to evaluate the bone density of patients suspected of having osteoporosis. QCT is limited by its high radiation dose and its ability to accurately measure only trabecular bone. DEXA scan, with AP lumbar spine, femoral neck, and Ward's triangle measurements, is the procedure of choice. DEXA AP lumbar spine measurements are more accurate in the young (age < 60), and femoral neck measurements are more accurate in the elderly (age ≥ 60). DEXA scans with a t score > -1 (defined as the difference in the standard deviation compared with peak bone mass in a young adult of the same race and sex) indicate an increased risk of fracture.

For patients who have hypercalciuria despite cessation of calcium and vitamin D therapy, abnormal screening labs for secondary causes, history of an osteoporotic related fracture, or > 5% decrease in bone mineral density from baseline should be considered for more intensive preventive therapies, which may include oral or intravenous bisphosphates, calcitonin, or thiazide diuretics. Endocrinology consultation should be considered.

While high-dose inhaled corticosteroids have been shown to decrease bone metabolism and suppress the hypothalamic-pituitary adrenal axis, the clinical implications of this observation are not known.

Patient Education Patient education is essential for successful management of asthma. Patient education should be arranged at the first visit for asthma and then continued. Critical education elements include:
- Demonstration of appropriate inhaler/spacer technique (see Annotation G, this module)
- Education concerning allergen avoidance (see Annotation I, this module)
- Recognition and response to exacerbations
- Peak flow use (see Annotation M)
- Medication roles and adverse effects (See Annotations F and G, this module)
- A written Asthma Action Plan should be reviewed (See Annotation M, this module).

TABLE OF EVIDENCE:

Intervention	Reference	Grade of Evidence	Strength of Recommendation
Self teaching can be an effective alternative to group teaching	Brough 1982	B	1
Group teaching/care is more effective than individual office teaching	Scott 1996	B	1
Patient education standards with measurable outcomes: a model for the future	Lorig 1993	C	2a
Influence of context and models of education on practice in patient education	Deccahe 1995	C	2a
Interdisciplinary process improves both quality of education and medical record documentation	Clafin 1996	C	2a
Primary care, adult patient population will increase their duration of physical activity in response to physician advice	Lewis 1993	B	1
Use of scenarios to measure asthma knowledge and specifically to assess practical knowledge of self-management of severe asthma	Kolbe 1996	C	2a
Self-management education improves knowledge in asthma patients but more importantly skills in disease management	Boulet 1995	B	1
Self-regulation improves use of more asthma management strategies	Clark 1994	B	2a
Meta-analysis of psych educational care in COPD: some types of care do improve well-being of COPD patients	Devine 1996	C	2a
Use of home PEF monitoring and a medicine self-management plan leads to a reduction in days lost from work, acute asthma attacks, days on antibiotic therapy, physician consults and ER admissions for asthma	Ignacio-Garcia 1995	A	1
Outpatient pulmonary rehabilitation can improve self-efficacy in participants' ability to manage or avoid breathing difficulty	Scherer 1996	C	2a

Intervention	Reference	Grade of Evidence	Strength of Recommendation
Various approaches to education of asthmatic adults, identifying those for whom particular approaches are most cost-effective	Wilson 1993	C	2a
Carefully designed asthma education for adults can improve understanding of their condition and increases motivation and confidence in controlling the condition	Wilson 1993	B	1
The more knowledge the patient has the more likely there will be adherence with medications.	Tellersel 1993	B	1
Peak flow measurement is a simple, inexpensive method of objectively determining airflow obstruction.	Li 1995	A	1
An evaluation instrument was found to be helpful in preparing COPD patient for self-care at home.	Swearengen 1989	C	2b
Despite minimal effect on measures of airway function, substantial changes in illness behavior and use of health care facilities can be achieved by a brief asthma education program.	Yoon 1993	B	1

O. (Box 17) Schedule Follow-Up Visit

OBJECTIVE: To determine frequency of follow-up visits

ANNOTATION:

Recommended frequency of follow-up:
- Mild Asthma: every 6 - 12 months
- Moderate Persistent Asthma: every 3 - 6 months
- Severe Persistent Asthma: every 1 - 3 months

More frequent visits may be necessary if clinically indicated.

Asthma Emergency Management for Adults and Children Age 6 Years and Over (A3a)

A. (Box 1) Patient Presenting with Signs and/or Symptoms Suggestive of Acute Asthma

OBJECTIVE: To recognize when a patient is experiencing an acute asthma exacerbation

ANNOTATION:

The quickest way to assess asthma severity is to evaluate respiratory status and patient comfort level.

- Common signs/symptoms of acute asthma are cough, wheeze, shortness of breath and chest tightness
- Other symptoms are anxiety, inability to lie down comfortably or sleep due to dyspnea
- Signs/symptoms may start abruptly or be progressive over hours to days
- Signs of acute, severe asthma are tachypnea, tachycardia, pulsus paradoxus, accessory respiratory muscle use, prolonged expiratory phase, hyperinflation of chest, appearance of anxiety, inability to speak in full sentences (age-dependent), cyanosis, and confusion or lethargy
- The prominence of wheezing may not correlate with the severity of the asthma exacerbation. Decreased wheezing may actually indicate worsening asthma and impending respiratory failure
- Triggers of asthma exacerbations include: upper respiratory infections (URIs), allergen exposure, exercise, toxic fume inhalation, tobacco smoke, and breathing cold or dry air.

A history of previous hospitalizations (especially to an ICU), previous need for mechanical ventilation for asthma, recent emergency department (ED) visits, and a history of prolonged, severe asthma are all risk factors for severe asthma exacerbations which may result in hospitalization.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Clinical assessment of acute asthma	Corbridge 1995 Lowenthal 1993 Strunk 1985	C	1
Risk factors for fatal asthma	NAEPP EPR-2 1997 Strunk 1989	C	1

B. (Box 2) Can a Life-Threatening Condition Other than Asthma be Identified?

OBJECTIVE: To exclude life-threatening conditions that may mimic acute, severe asthma

ANNOTATION:

Evaluate for severe asthma or other pulmonary causes, cardiac causes or other disorders which cause upper or lower airway obstruction. Identify pregnant asthmatic patients early (See Annotation D, this module).

Differential diagnosis of Acute Shortness of Breath:
- Exacerbation of COPD
- Pulmonary edema (consider pulmonary and cardiac causes)
- Pulmonary contusion/chest trauma
- Upper airway obstruction (e.g., foreign body, epiglottitis, laryngeal dysfunction, vocal cord dysfunction [VCD])
- Lower airway obstruction (e.g., neoplasm, foreign body, tracheal/subglottic stenosis, tuberculosis)
- Pneumonia or pulmonary infiltration with eosinophilia
- Pulmonary embolus
- Pneumothorax
- Anaphylaxis following hypersensitivity reactions to drugs (e.g., antibiotics), foods, insect stings or allergy injections

- Idiosyncratic reactions to drugs (e.g., aspirin, NSAIDs, beta-blockers, ACE-inhibitors)

Patients who do not have an identified alternative cause for their respiratory distress should continue to be treated for asthma. Also, those patients who have asthma in addition to other causes of respiratory distress should continue to be treated for asthma.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Differential diagnosis of asthma	NAEPP EPR-2 1997 Chernick & Boat Eds. 1998	C	1

C. (Box 4) Assess Severity of Asthma Exacerbation. Do Pulse Oximetry. Have Patient Perform PEF or FEV_1 if Clinically Able.

OBJECTIVE: To assess severity of asthma exacerbation using physical examination, PEF or FEV_1, and pulse oximetry

ANNOTATION:

To evaluate the severity of asthma exacerbation, attention to the chest and neck exam and general appearance, vital signs, and PEF or FEV_1 is necessary. An arterial blood gas (ABG) measurement should be done in patients in severe respiratory distress.

- **General appearance** Observe for the patient being anxious, working hard to breathe, and unable to speak. These are all signs of a severe asthma exacerbation
- **Vital signs** Severe asthma exacerbations are usually associated with the following vital signs: RR >30/min, pulse > 120/min, pulsus paradoxus (PP) > 12-15 mm Hg. A PP > 18 mm Hg indicates severe airflow obstruction
- **Wheezing** Wheezing correlates poorly with the degree of airflow limitation
- **Chest Retractions** The presence of chest retractions suggests severe airway obstruction
- **Peak flow (PEF)** A PEF or FEV_1 of < 50% of the predicted value or the patient's personal best (usually corresponding to a PEF < 120 L/min or a FEV_1 < 1L in adults) indicates a severe asthma exacerbation (See **Assessing Severity Using Signs, Symptoms, and Functional Assessment Table** and Discussion immediately below)
- **ABG** Patients who are in severe respiratory distress should have their ventilatory status assessed by measuring arterial PCO_2 with an ABG

DISCUSSION:

TABLE: ASSESSING SEVERITY USING SIGNS, SYMPTOMS, AND FUNCTIONAL ASSESSMENT

	Mild	**Moderate**	**Severe**	**Respiratory Failure Imminent**
Symptoms Breathless; Preferred position	While walking; Can lie down	While talking; Prefers sitting	While at rest; Sits upright	While at rest; Sits upright
Talks in:	Sentences	Phrases	Words	
Alertness	May be agitated	Usually agitated	Usually agitated	Drowsy or confused
Signs Respiratory rate	Increased	Increased	Often > 30/minute	Often > 30/minute
Use of accessory muscles with suprasternal retractions	Usually not	Commonly	Usually	Paradoxical thoraco-abdominal movement
Wheeze	Moderate often only end expiratory	Loud throughout exhalation	Usually loud throughout inhalation and exhalation	Absence of wheeze
Pulse/minute	< 100	100 to 120	> 120	Bradycardia
Pulsus paradoxus	Absent < 10 mmHg	May be 10 to 25 mmHg	Often present > 25 mmHg (adult)	Absence suggests respiratory muscle fatigue
Functional Assessment PEF or FEV_1 (% of personal best or predicted value)	80%	50-80%	< 50% or response (improvement) lasts < 2 hours	< 20%
PaO_2 (on room air) if obtained	N/A	≥60 mm Hg (test usually not necessary)	< 60 mm Hg Possible cyanosis	
$PaCO_2$ (on room air) if obtained	N/A	<42 mm Hg (test usually not necessary)	≥ 42 mm Hg Possible respiratory failure	≥ 42 mm Hg Possible respiratory failure
SaO_2 or S_PO_2 percent (on room air) at sea level	N/A	91 to 95%	< 91%	< 90%

Risk factors for life-threatening exacerbations of asthma include: history of severe asthma, poorly controlled asthma of any severity, psychological factors, failure by the patient or patient's physician to recognize severity of asthma, nonadherence to medical therapy, and daily use of corticosteroids. Previous hospitalization for asthma and history of intubation with mechanical ventilation for asthma increase the likelihood that patient will require in-hospital care.

Most patients with severe asthma hyperventilate in proportion to the severity of the attack and use accessory muscles during inspiration and expiration. Diffuse wheezes and rhonchi are frequently present during both phases of respiration as well. Hypoventilation or a silent chest may be a sign of imminent respiratory failure.

Absolute $PaCO_2$ is not necessarily a good indicator of asthma severity, but a change in $PaCO_2$ level may be more significant. Some patients suffer respiratory arrest at high levels of $PaCO_2$ and others at relatively normal levels of $PaCO_2$. However, a $PaCO_2 \geq 42$ mm Hg with signs of respiratory distress is an indicator of severe acute asthma, as is $PaCO_2$ in normal range that is out of proportion to respiratory effort. Prolonged severe asthma can result in metabolic acidosis. Increased work of breathing associated with severe asthma in the elderly or in patients with other chronic diseases lowers the threshold for deciding to intubate.

Severely stressed patients who are barely able to speak should not be asked to perform FEV_1 and/or PEF. In patients who can perform these tests, they are usually < 50% of their personal best or predicted value in severe asthma.

Laboratory tests may occasionally be useful in evaluating severe asthma and diagnosing comorbid disease. Consider CBC with differential, electrolytes, phosphate, magnesium, ionized calcium, lactate levels, arterial blood gas, chest x-ray, EKG.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Position of diaphragm in acute asthma	Brenner 1983	B	2a
Assessment and management of acute life-threatening asthma	Fitzgerald 1998	C	2a
Pulsus paradoxus as a sign of severity	Knowles 1973	C	2a
Assessment for asthma severity	Fischl 1981	C	2a
Relationship of wheezing to the severity of obstruction in asthma	Shim 1983	C	2a
Risk factors for fatal asthma	NAEPP EPR-2 1997	C	1
Assessing severity of adult asthma and need for hospitalization	Cone 1985	C	2a
Arterial blood gases and pulmonary function testing in acute bronchial asthma: predicting patient outcomes	Nowak 1983	C	2a
Asthma in adults	Mathison, DA: Middleton E, Reed CE Eds. 1998	C	2a

D. (Box 5) Initiate Inhaled Short-Acting Beta$_2$-Agonist and Oxygen Therapy to Keep SaO_2 > 90%

OBJECTIVE: To initiate effective treatment quickly

ANNOTATION:

Administration of inhaled short acting beta$_2$-agonists and oxygen will often produce rapid improvement and prevent clinical complications. Keep SaO_2 > 90% (> 95% for pregnant women). This can usually be accomplished with 1-4 liters of supplemental oxygen delivered via nasal cannula.

DISCUSSION:

Administer inhaled beta$_2$-agonists by inhaler with spacer/holding chamber or nebulizer. Administration of 4 to 8 puffs of albuterol by inhaler with holding chamber every 20 minutes for up to a total of 24 puffs over one hour is as effective as nebulizer treatments, provided the patient has appropriate inhaler technique (See Annotation H dosages and Table of Evidence, this module).

E. (Box 6) Is There Impending Respiratory Failure?

OBJECTIVE: To identify patients at risk for respiratory arrest

ANNOTATION:

Prompt recognition of the signs of respiratory failure is critical for initiation of appropriate treatment that may prevent cardiopulmonary arrest and death.

Suspect impending respiratory failure if any of the following are present:

- Altered level of consciousness (severe agitation, confusion, obtundation, or coma)
- Cyanosis or refractory hypoxemia (PaO_2 <60 mm Hg or SaO_2 < 90% while breathing room air at sea level)
- $PaCO_2 \geq 42$ mm Hg in a patient experiencing respiratory distress
- Paradoxical thoracoabdominal movement
- Silent chest on auscultation (absence or cessation of wheeze)
- Bradycardia
- Evidence of exhaustion

DISCUSSION:

The majority of asthma deaths are preventable provided the severity of the exacerbation is recognized and appropriate treatment is initiated immediately. Respiratory acidosis due to respiratory muscle fatigue, hypotension, or poor oxygenation contributes to an increased risk for cardiopulmonary arrest.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Indicators of respiratory failure	NAEPP EPR-2 1997	C	1

F. (Box 7) Consider Endotracheal Intubation. Admit to ICU

OBJECTIVE: To outline the initial steps for stabilization of a patient with severe asthma and impending respiratory failure

ANNOTATION:

Initial strategies for stabilization may include:

- 100% FiO_2 by non-rebreather face mask
- Continuous pulse oximetry monitoring
- Inhaled short acting $beta_2$-agonist hourly or continuously, with the addition of inhaled anticholinergic agents (ipratropium) for selected patients
- Obtain intravenous access, correct hypovolemia if present, but avoid over-hydration
- Intravenous corticosteroids (120 to 240 mg methylprednisolone per day, approximately 4 mg/kg/day for children [See Annotation H, this module])
- Laboratory and other diagnostic studies as indicated: consider CBC, electrolytes, ABG, chest radiograph, EKG, theophylline level (if on theophylline)
- For adult patients, may consider non-invasive positive pressure ventilation. If respiratory failure or respiratory arrest occurs, endotracheal intubation should be performed.
- Sedation; neuromuscular blockade (NMB) may be considered in some patients in order to achieve ideal patient-ventilator interaction; 100 percent FiO_2.

General guidelines for mechanical ventilation:

- Aim for adequate gas exchange with the lowest possible peak inspiratory pressure (PIP)
- Low tidal volumes (5 to 8 ml/kg [ideal body weight]) and low ventilator rates (approximately 10/min)
- Adjust inspiratory flow rate, respiratory rate and I:E ratio (prolong expiration) to allow adequate ventilation and minimize PIP
- Use permissive hypercapnia to avoid barotrauma associated with high PIP
- Keep arterial pH > 7.1; $PaCO_2$ < 120 mm Hg; PIP < 50 cm H_2O (≤ 30 cm H_2O optimal) as long as hemodynamically stable
- Sedate for optimal patient-ventilator interaction.
- Titrate oxygen to maintain oxygen saturation > 90% (> 95% in pregnant women)
- Elevate head at >30 degrees.
- Utilize neuromuscular blockade only if providers are experienced in their use

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Intensive care intubation, mechanical ventilation, continued pharmacologic treatment and neuromuscular blockade are effective in management of severe asthma	Braman 1990 Beveridge 1996 Bishop 1993 NAEPP, EPR-2 1997 Zimmerman 1993 JTFPP 1995 LeSon 1995 Burrows 1995 Jagoda 1997 Bellomo 1994 Dworkin and Kattan 1989 Cox et al. 1991	C	2a
Noninvasive positive pressure ventilation may be a safe alternative to intubation in adults	Meduri 1996 Pollach 1995	B	2a
Permissive hypercapnia is safe and reduces peak inspiratory pressures	Hickling 1994 Smith 1988 Tuxen 1982; 1992 Dries 1995 Cox et al. 1991	C	2a
Pharmacologic intervention	Jagoda 1997	C	2a

G. (Box 8, 11 and 13) Is There a Good Response to Treatment?

OBJECTIVE: To define a good response to treatment and identify those patients who have improved enough to be discharged to home

ANNOTATION:

A good response to therapy includes the following criteria, and a patient should meet these criteria before being discharged home:

- FEV_1 or PEF ≥ 70% of personal best or of the predicted value
- No respiratory distress
- Physical exam is at patient's baseline
- Room air SaO_2 ≥ 94%

DISCUSSION:

Many patients respond transiently to the initial treatment. If the symptomatic response is sustained for at least one hour, the patients are assessed with objective measurement of peak flow and also by symptoms. If these measures are adequately improved, then the patient can be safely discharged with appropriate follow-up arrangements and education.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Assessing response to therapy	NAEPP EPR-2 1997	C	2a

H. (Box 9) Consider Alternative Diagnoses, and Continue or Adjust Pharmacologic Therapy

OBJECTIVE: To determine what to do when there has not been a good response to therapy

ANNOTATION:

Alternative diagnoses should be considered in patients who fail to respond to asthma therapy.

Adjust pharmacologic therapy:
- Continue inhaled short-acting $beta_2$-agonists
- Treat hypoxemia defined as $SaO_2 < 90\%$ or $PaO_2 < 60$ mm Hg while breathing room air. Oxygen saturation level should be kept at > 90% (or > 95% in pregnant women)
- Note the dosages of drugs for asthma exacerbations in emergency medical care or hospitalized patients in the **Hospital Checklist for Inpatients with Asthma Exacerbations Table** in Annotation L of Module A3a.

DISCUSSION:

- The usual regimen is to continue the frequent multiple daily dosing of corticosteroids until the patient achieves a FEV_1 or PEF of ≥ 50 percent predicted or personal best and then lower the dose to twice daily. This usually can be done within 48 hours
- No definite advantage has been found for higher dose corticosteroids in severe asthma exacerbations, nor is there any advantage for intravenous administration over oral therapy provided gastrointestinal transit time or absorption is not impaired. Corticosteroid therapy following a hospitalization or emergency department visit is usually continued for 3 to 10 days. If patients are then started on inhaled corticosteroids, studies indicate there is no need to taper the systemic corticosteroid dose
- If the follow-up systemic corticosteroid therapy is to be given once daily, one study indicates it may be more clinically effective to give the dose in the afternoon at around 3:00 pm

TABLE: MEDICATION DOSES (ADAPTED FROM THE NAEPP EPR-2 1997)

Medications	Adults' and Older Children's Dose	Comments
Inhaled short-acting beta$_2$-agonists **Albuterol**: Metered dose inhaler (MDI) (90 mcg/puff) with spacer/ holding chamber	4 to 8 puffs every 20 minutes (or 24 puffs per hour); then every 1-4 hours as need	As effective as nebulized therapy if patient is able to coordinate inhalation maneuver
Nebulizer solution: (5 mg/ml)	2.5 to 5 mg every 20 minutes for 3 doses, then 2.5 to 10 mg every 1 to 4 hours as needed, or 10 to 30 mg/hour continuously	Only selective beta$_2$-agonists are recommended. For optimal delivery, dilute aerosols to minimum of 4 ml; use a gas flow of 6 to 8 L/minute
Systemic (subcutaneous) beta-agonists **Epinephrine**: 1:1000 (1mg/ml)	0.3 to 0.5 mg every 20 minutes for 3 doses subcutaneously	No proven advantage of systemic therapy over aerosol. May be hazardous in patients with heart disease.
Anticholinergics **Ipratropium bromide**: MDI (18 mcg/ml)	4-8 puffs as needed	Dose delivered from MDI is low and has not been studied in asthma exacerbations.
Nebulizer solution: (0.25 mg/ml; 0.5 mg/vial)	0.5 mg every 30 minutes for 3 doses then every 2 to 4 hours as needed	May mix in same nebulizer with albuterol. Should not be used as first line therapy; may be added to beta$_2$-agonist therapy.
Corticosteroids **Prednisone** **Methylprednisolone** **Prednisolone**	120 to 240 mg/day in 3 or 4 divided doses for 48 hours, then 60 to 80 mg/day until PEF reaches 60% of predicted value or personal best (See Discussion)	For outpatient 'burst' use 40 to 60 mg/day in single or two divided doses for 3-10 days (See Discussion)

TABLE OF EVIDENCE:

DOSAGE AND ROUTE OF BRONCHODILATORS

Intervention	References	Grade of Evidence	Strength of Recommendation
Anticholinergic therapy with beta$_2$-agonist is no better than beta$_2$-agonist alone	O'Driscoll et al. 1989 Higgins 1988 McFadden 1997 Fitzgerald 1997 Karpel 1996	A	1
Ipratropium (anticholinergic) therapy for acute, severe asthma in children NOTE: all studies were performed in emergency departments	Reisman et al. 1988 Schuh et al. 1995 Qureshi et al. 1997 Ducharme and Davis 1997 Qureshi et al. 1998 Zorc et al. 1999	A	1
Albuterol delivered by MDI with spacer or nebulizer are equivalent in patients capable of cooperating	Colacone 1993 Wildhaber 1997 Chou 1995	B	1

Intervention	References	Grade of Evidence	Strength of Recommendation
Intermittent and continuous nebulization are equivalent	Reisner 1995 Lin 1993 Rudnitsky 1993	B	2a

TABLE OF EVIDENCE:

DOSAGE AND ROUTE OF CORTICOSTEROID THERAPY

Intervention	References	Grade of Evidence	Strength of Recommendation
Oral and parenteral administration has the same results provided normal absorption	Ratto 1988 Harrison 1986 Hoffman 1988	A	1
Steroid dosage 120-180 mg prednisone or equivalent	Tanaka 1982 Marquette 1995 Haskell 1983 Emerman 1995 Raimondi 1986	A	1
Corticosteroids are useful in the ED setting	Schneider 1988 Littenberg 1986 Chapman 1991	C	2a
Afternoon corticosteroid doses are more effective	Beam et al. 1992	A	2a

I. (Box 12) Treat with Short-Acting Beta$_2$-Agonists and Systemic Corticosteroids; Reassess at 1-3 Hours

OBJECTIVE: To specify continued treatment for patients who have not had a good response to initial therapy

ANNOTATION:

Patients who fail to have a good response to therapy require continued management and observation.

Treatment should include:
- Inhaled short-acting beta$_2$-agonists
- Systemic corticosteroids
- Continuation of treatment for another 1-3 hours

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Recommendation for continued treatment of an asthma exacerbation	NAEPP EPR-2 1997	C`	1

J. (Box 14) Is There a Partial Response?

OBJECTIVE: To identify patients who have had an incomplete response to asthma therapy but have had enough improvement sustained for at least one hour to consider management at home with appropriate follow-up

ANNOTATION:

In a partial response, the following are present:
- FEV_1 or PEF ≥ 50 percent but < 70 percent of personal best or predicted value
- Mild-to-moderate symptoms persist, but the patient has had significant clinical improvement

The decision to send a patient in this group home should be individualized and depends, in part, on the patient's understanding of the Action Plan and access to care.

K. (Box 16) Consult with Admitting Physician Regarding Appropriate Level Bed (ICU, Hospital Ward)

OBJECTIVE: To identify patients with a poor response to treatment who require continued management in an ICU or other inpatient setting

ANNOTATION:

Patients with a poor response usually require admission to an ICU or other appropriate inpatient area. In a poor response, there is minimal improvement and any one of the following is present:

- Drowsiness, confusion
- Severe breathlessness
- FEV_1 or PEF < 50% of the predicted value or patient's best value
- $PaCO_2$ ≥ 42 mm Hg
- Hypoxemia

Suspect impending respiratory failure if any of the following is present:

- Altered level of consciousness (severe agitation, confusion, obtundation, or coma)
- Cyanosis or refractory hypoxemia (PaO_2 <60 mm Hg or SaO_2 < 90% while breathing room air at sea level)
- $PaCO_2$ ≥ 42 mm Hg in a patient experiencing respiratory distress
- Paradoxical thoracoabdominal movement
- Silent chest on auscultation (absence or cessation of wheeze)
- Bradycardia
- Evidence of exhaustion

If necessary, begin steps to prepare patient for transfer. Once patients have improved from a poor response, they can be cared for in a less intensive environment.

L. (Box 17) Admit/Continue at Appropriate Level of Care

OBJECTIVE: To outline the general guidelines for inpatient management outside of the ICU setting

ANNOTATION:

For patients admitted to the ICU (See Annotation F, this module).

The following general guidelines are not intended to provide a detailed plan for inpatient management. Hospital admissions should be seen as opportunities for providing additional patient education and establishing a written Action Plan.

For hospitalized patients in a non-ICU setting:
- Administer inhaled $beta_2$-agonist by MDI 4 to 8 puffs with spacer/holding chamber every 1-4 hours, or by nebulizer (see Annotation H, this module, for dosages) in patients not capable of coordinating the inhalation maneuver
- Consider adding an inhaled anticholinergic (ipratropium) for patients not improving with $beta_2$-agonist therapy alone
- Administer systemic (oral or intravenous) corticosteroids
- Administer supplemental oxygen

- Monitor FEV_1 or PEF at least daily
- Monitor SaO_2, pulse and respiratory rate
- Perform frequent clinical assessment

DISCUSSION:

TABLE: HOSPITAL CHECKLIST FOR INPATIENTS WITH ASTHMA EXACERBATIONS

Intervention	Dose/Timing	Education/Advice
Inhaled medications (MDI) + spacer/holding chamber) $Beta_2$-agonist Corticosteroids	Select agent, dose, and frequency (e.g., albuterol, 2 to 6 puffs every 3 to 4 hours prn; inhaled corticosteroid, 16 to 24 puffs per day of beclomethasone or equivalent)	Teach purpose Teach technique Emphasize need for spacer/holding chamber Check patient technique
Oral medications	Select agent, dose and frequency (e.g., prednisone 20 mg bid for 3 to 10 days	Teach purpose Teach side effects
Peak flow meter	Measure PEF AM and PM and record best of three tries each time	Teach purpose Teach technique Distribute peak flow meter and diary
Follow-up visit	Make appointment for follow-up care with primary clinician or asthma specialist within 7 days of discharge	Advise patient (or caregiver) of date, time and location of appointment
Written Action Plan	Before or at discharge	Instruct patient (or caregiver) on simple plan for actions to be taken for symptoms, signs, and PEF values suggesting recurrent airflow obstruction

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
In-patient management of asthma	NAEPP EPR-2 1997	C	1

M. (Box 18) Document the Patient's Post-Treatment Status at the Time of Discharge from Care, Including Vital Signs and Pulse Oximetry

OBJECTIVE: To emphasize the documentation of discharge status

ANNOTATION:

Document the patient's condition at the time of hospital discharge:
- Record discharge time with brief description of patient's appearance
- Note respiratory effort and use of accessory muscles
- Objective measurements should include:
  - Pulse
  - Respiratory rate
  - Blood pressure (in all patients, including children)
  - Pulse oximetry (while breathing room air)
  - Pulmonary function (FEV_1 or PEF)

N. (Box 19) Provide Patient Education and Written Action Plan

OBJECTIVE: To prepare the patient/parent for self-management of asthma

ANNOTATION:

Disease management education:
- Reinforce written self-management collaborative Action Plan
- Arrange for follow-up
- Review medication use
- Continue treatment with inhaled $beta_2$-agonists
- Continue course of oral corticosteroids
- Initiate inhaled corticosteroids with holding chamber at dose appropriate to severity, when indicated (See Annotation H, Module A1a).

O. (Box 20) Schedule Appropriate Follow-Up

The timing and type of follow-up depends on the severity of the exacerbation. Many experts recommend that patients should follow up within 7 days with a primary care manager (PCM) or asthma specialist in person. Patients who required an ICU admission should be referred to an asthma specialist for consultation within 1-2 months. All asthma patients should have a PCM or be referred to get a PCM.

Asthma Telephone Triage Management for Adults and Children Age 6 Years and Over (A4a)

A. (Box 2) Are Patient's Symptoms Consistent with Asthma?

OBJECTIVE: To determine whether the patient's respiratory symptoms are due to asthma

ANNOTATION:

Please note that this telephone management guideline should only be used for patients who have been previously diagnosed with asthma.

The quickest way to determine whether the patient's respiratory complaints are caused by asthma is to inquire about the patient's respiratory signs/symptoms and to use objective measures of airway obstruction, e.g., peak flow (PEF).

- The usual symptoms of acute asthma are shortness of breath, chest tightness, and cough
- Symptoms may start acutely or progress over hours to days
- Signs of acute asthma which may be useful when attempting to determine the respiratory status of the patient include: degree of accessory respiratory muscle use, respiratory rate, wheezing, anxiety level, and the ability to speak in full sentences
- Note: the prominence of wheezing may not correlate with the severity of the asthma exacerbation. The absence of wheezing may actually indicate worsening asthma and impending respiratory failure. In addition, wheezing is difficult to assess over the telephone
- Peak flow readings should be compared to the patient's best (normal) value

Triggers of asthma exacerbations include: upper respiratory infections, allergen exposure, exercise, toxic fume inhalation, tobacco smoke, and breathing cold or dry air.

A history of previous frequent hospitalizations, previous need for intubation, recent emergency department (ED) visits, are all risk factors for difficult to control or less responsive asthma attacks. Use caution when attempting to manage patients with these risk factors in their home.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Clinical assessment of asthma	McFadden et. al. 1973 Kerem et al. 1991 Schuh et al. 1997	B	1
Signs/symptoms of acute asthma	NAEPP EPR-2 1997 Strunk 1989	C	1

B. (Box 3) Is There Evidence of a Severe Asthma Exacerbation?

OBJECTIVE: To define a severe asthma exacerbation

ANNOTATION:

The severity of an asthma exacerbation is based upon both objective measures of airway obstruction (PEF) and respiratory signs/symptoms. Patients suffering from severe exacerbations of asthma should not be managed at home.

The following suggest a severe exacerbation:
- Shortness of breath, especially at rest
- Chest retractions
- Requiring $beta_2$-agonist therapy more frequently than every two hours
- Rapid respiratory rate

- PEF < 50% of the patient's personal best value

Question the patient/parent concerning the signs/symptoms and PEF values as noted in the following **Assessment of Asthma Severity Table** immediately below.

TABLE: ASSESSMENT OF ASTHMA SEVERITY

Sign/Symptom or PEF Reading	Severity of the Asthma Exacerbation		
	Mild	**Moderate**	**Severe**
PEF (% of predicted or personal best value)	≥ 80%	50-79%	< 50%
Respiratory rate Children Adults	 < 30/min < 20/min	 30-40/min 20-30/min	 > 40/min > 30/min
Accessory muscle use (chest retractions)	*not present*	*may be present*	*usually present*
Shortness of breath	*not present*	*may be present*	*usually present*

DISCUSSION:

Please note that patients suffering from severe exacerbations of asthma should not be managed at home; they should be instructed to seek immediate medical attention (see Box 4 of the algorithm).

Patients with a history of severe asthma exacerbations requiring hospitalization or ED visits are more likely to be suffering from acute, severe asthma. Use caution when attempting to manage these patients at home.

The assessment of airflow limitation using both objective measures, whenever possible, and signs/symptoms of asthma are essential to guide asthma therapy. Relying on the patient or caregiver to provide this information to the clinician by phone adds potential uncertainty. Peak flow readings provide a useful objective measure of airway obstruction. Some patients with severe airway obstruction may not experience dyspnea, tachypnea, or chest retractions. In these patients the PEF readings are essential to accurately determine the severity of the asthma exacerbation. The signs and symptoms which correlate best with airway obstruction are shortness of breath, tachypnea, chest retractions.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Signs and symptoms of severe asthma exacerbations	NAEPP ERP-2 1977	C	1
Risk factors for fatal asthma	Strunk 1989	B	1
Asthma severity may be underestimated without objective assessment	Kikuchi et al. 1994 Holleman et al. 1995	C	2a
Clinical assessment of asthma	McFadden et al. 1973 Kerem et al. 1991 Schuh et al. 1997	A	1

C. (Box 6) Does the Patient Have A Specific Written Action Plan, and Medication and Equipment for Home Treatment?

OBJECTIVE: To determine whether the patient has an appropriate written Action Plan, and proper medication and equipment to enable asthma care to continue at home

ANNOTATION:

The patient's written Action Plan should include:
- Warning signs of acute asthma
- Means to determine asthma severity
- Medication management
- Acute episode management
- Chronic asthma management
- School/Day Care (children) management
- Signs and symptoms of worsening asthma

Patients must have an adequate supply of $beta_2$-agonists and either a MDI, dry powder inhaler, or nebulizer. They must also have ready access to oral corticosteroids.

DISCUSSION:

Action Plans rely on both symptoms and peak flow readings. However, some of the children will not be able to perform PEF reliably. The patient/parent should be able to find and follow the written Action Plan. It is a good idea to review the written Action Plan instructions with the care provider.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Symptom and PEF-based Action Plan s are equivalent in reducing asthma flares	NAEPP EPR-2 1997 Grampian 1994 Charlton et al. 1994 Malo 1993 Turner 1998	C	2a

D. (Box 9) Can the Patient be Managed Safely at Home?

OBJECTIVE: To highlight criteria for safe home management

ANNOTATION:

Many patients without Action Plans can still be managed at home. The criteria for safe home management are:
- The patient/caregiver must be knowledgeable, competent, and able to follow instructions
- There must be an adequate supply of appropriate medication at home
- The patient/caregiver must be able to adequately describe the patient's signs and symptoms
- The patient must have ready access to EMS services or other means to quickly obtain urgent care should the asthma attack become severe
- There should be no language or other communication difficulties which could interfere with carrying out instructions
- The patient does not have a severe asthma exacerbation

Patients who do not meet all of the above criteria should seek medical attention and should not be managed at home.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Criteria for managing patients at home	NAEPP ERP-2 1997	C	1

E. (Box 10) Manage at Home Without Written Action Plan: Assess Severity of Symptoms, Initiate Beta$_2$-Agonist therapy, and Recommend Further Care as Appropriate

OBJECTIVE: To outline the home treatment for patients who do not have an Action Plan but still meet criteria (Annotation D, this module) for being safely managed at home

ANNOTATION:

The management of a patient who does not have a written Action Plan consists of the following:
- Assessing the severity of the asthma exacerbation (see **Assessment of Asthma Severity Table in Annotation B,** this module)
- Instructing on use of inhaled beta$_2$-agonists (See **Medication Doses Table** below, this annotation)
- Considering the use of systemic corticosteroids (See **Medication Doses Table** below, this annotation)
- Discussing warning signs of worsening asthma
- Instructing on when and how to seek medical attention
- Determining the appropriate means of re-evaluation and follow-up

DISCUSSION:

Both peak flow measurements and asthma signs/symptoms are important in determining the severity of the asthma exacerbation. The management strategy will be dictated by the severity of the exacerbation. Assessment of asthma severity should include the following: measurement of PEF and comparison to the patient's best or normal value, and also determining the degree of shortness of breath, tachypnea, chest retractions, wheezing, frequency of beta$_2$-agonist treatments within the past 24 hours, and response to therapy. Improvement with beta$_2$-agonist therapy is reassuring but does not necessarily mean that the exacerbation is resolving. Many patients will require a short course of systemic corticosteroids, e.g., prednisone 2 mg/kg/day for 3-10 days (maximum of 60 mg), to clear the exacerbation. Drug doses are listed in the **Medication Doses Table** immediately below.

TABLE: MEDICATION DOSES (ADAPTED FROM THE NAEPP EPR-2 1997)

Medications	Dose	Comments
Inhaled short-acting beta$_2$-agonist Albuterol: MDI (90 mcg/puff) with spacer/holding chamber Nebulizer solution (5 mg/ml)	 4-8 puffs every 20 minutes x 3 doses and then 1-4 hours as necessary (2.5-5 mg) every 3-4 hours	 MDI is as effective as nebulized therapy if patient is able to coordinate the inhalation maneuver
Corticosteroids: Prednisone Methylprednisolone (Medrol)	Approximately 2 mg/kg/day (maximum of 60 mg) as either a single daily dose or divided bid for 3-10 days	

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Home use of oral corticosteroids is effective	Chapman 1991 Fiel 1983 Harris 1987 Despande 1986 Loren 1980	A	1
Oral corticosteroids are useful in treating acute asthma	Weinberger 1988 Raimondi et al. 1986 Emerman et al. 1995	A	1
Albuterol delivered by MDI/holding chamber and nebulizer are equivalent	Kerem et al. 1993 Chou et al. 1995 Williams et al. 1996 Amirav and Newhouse 1997	A	1

F. (Box 14) Follow-up Therapy

OBJECTIVE: To outline appropriate follow-up

ANNOTATION:

The timing and type of follow-up depend on the severity of the asthma exacerbation. Most patients should be followed up with a telephone call within 24 hours. Then repeat patient contact either in person or by telephone 5-7 days later. All patients with asthma should have a primary care manager (PCM) and, ideally, follow-up should be arranged with the PCM.

Stepcare Approach for Prescribing Asthma Medications Based on Severity
Annotations for Table A-Adults: For Adults and Children Age 6 Years and Over

(Please note that Table A-Adults Annotations A-a through H-a apply to Table A references in Algorithms A1a and A2a, while Table A-Peds Annotations A-p through H-p apply to Table A references in A1p and A2p. Table A is located immediately after the algorithms section)

A-a. Table A-Adults: Mild Intermittent Asthma Severity Level

OBJECTIVE: To define mild intermittent asthma signs/symptoms

ANNOTATION:

Asymptomatic and normal PEF between exacerbations. Exacerbations are brief (from a few hours to a few days); intensity may vary. Nighttime symptoms ≤ 2 times a month or symptoms ≤ 2 times a week. Lung function (*only* for adults and for children who can perform spirometry or use peak flow meters): FEV_1 or PEF ≥ 80 percent personal best or the predicted value, PEF variability < 20 percent.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Asthma severity classification	NAEPP EPR-2 1997	C	1

B-a. Table A-Adults: Mild Intermittent Asthma (Step 1) Drug Therapy

OBJECTIVE: To define the therapy for mild intermittent asthma

ANNOTATION:

Long-term control: daily medication is not usually needed. For quick relief: short-acting bronchodilator (e.g., inhaled $beta_2$-agonists) as needed for symptoms; intensity of treatment will depend on severity of the exacerbation. The use of short-acting inhaled $beta_2$-agonists more than twice a week may indicate the need to initiate long-term control therapy.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
General guidelines	NAEPP EPR-2 1997	C	1
Short-acting $beta_2$-agonists	Drazen et al. 1996	A	1

C-a. Table A-Adults: Mild Persistent Asthma Severity Level

OBJECTIVE: To define mild persistent asthma signs/symptoms

ANNOTATION:

Exacerbations may affect activity. Nighttime symptoms > 2 times a month, or symptoms > 2 times a week but less than 1 time a day. Lung function (*only* for adults and for children who can perform spirometry or use peak flow meters): FEV_1 or PEF ≥ 80 percent personal best or predicted value, PEF variability 20 to 30 percent

(See Annotation A-a, above, for **Table of Evidence**).

D-a. Table A-Adults: Mild Persistent Asthma (Step 2) Drug Therapy

OBJECTIVE: To define the therapy for mild persistent asthma

ANNOTATION:

Long-term control with low-dose inhaled corticosteroid. May also consider theophylline SR. Other daily medication, e.g., cromolyn or nedocromil may be considered for patients > 6 years old.

For quick relief, use short-acting bronchodilator (e.g., inhaled short-acting $beta_2$-agonist) as needed for symptoms; intensity of treatment will depend on severity of exacerbation; the use of short-acting inhaled $beta_2$-agonist on a daily basis, or increasing use, indicates the need for additional long-term control therapy.

TABLE: ESTIMATED COMPARATIVE DAILY DOSAGES FOR INHALED CORTICOSTEROIDS

Drug	Low Dose	Medium Dose	High Dose
Beclomethasone dipropionate 42 mcg/puff 84 mcg/puff	168 to 504 mcg (4 to 12 puffs) (2 to 6 puffs)	504 to 840 mcg (12 to 20 puffs) (6-10 puffs)	> 840 mcg (> 20 puffs) (> 10 puffs)
Budesonide turbuhaler 200 mcg/inhalation	200 to 400 mcg (1 to 2 inhalations)	400 to 600 mcg (2 to 3 inhalations)	> 600 mcg (> 3 inhalations)
Flunisolide 250 mcg/puff	500 to 1,000 mcg (2 to 4 puffs)	1,000 to 2,000 mcg (4 to 8 puffs)	> 2,000 mcg (> 8 puffs)
Fluticasone MDI: 44, 110, 220 mcg/puff Dry powder inhaler (DPI): 50, 100, 250 mcg/puff	88 to 264 mcg	264 to 660 mcg	> 660 mcg (> 6 inhalations—100 mcg) or (> 2 inhalations—250 mcg)
Triamcinolone acetonide 100 mcg/puff	400 to 1,000 mcg (4 to 10 puffs)	1,000 to 2,000 mcg (10 to 20 puffs)	> 2,000 mcg (> 20 puffs)

TABLE: LEUKOTRIENE MODIFIERS

Drug	Dosage Form	Dose	Age Approval Use	LFT Required
Montelukast	5 mg tab 10 mg tab	Children (6-14 yrs) 5 mg qhs Adults (> 15 yrs) 10 mg qhs	≥ 6 yrs	
Zafirlukast	20 mg tabs	20 mg bid (Take on empty stomach)	≥ 12 yrs	
Zileuton	600 mg tabs	600 mg qid	≥ 12 yrs	Baseline or periodic (e.g., q month x 3 months) and then (e.g., q 2-3 months x 1 year)

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
General guidelines	NAEPP EPR-2 1997	C	1
Inhaled corticosteroids	Barnes et al. 1993 Haahtela et al. 1991 Haahtela et al. 1994	A	1
Cromolyn sodium and nedocromil	Lal et al. 1993 Schwartz et al. 1996	A	2a
Methylxanthines	Weinberger et al. 1996	C	2a
Leukotriene modifiers are effective in mild persistent asthma	Israel et al. 1996 Spector et al. 1994	A	1
Short-acting beta$_2$-agonists: PRN and regularly scheduled doses are equivalent	Drazen et al. 1996	A	1

E-a. Table A-Adults: Moderate Persistent Asthma Severity Level

OBJECTIVE: To define moderate persistent asthma signs/symptoms

ANNOTATION:

Daily use of inhaled short-acting beta$_2$-agonist. Daily symptoms, exacerbations ≥ 2 times/week and affect activity which may persist for days. Nighttime symptoms > 1 time a week. Lung function (*only* for adults and for children who can perform spirometry or use peak flow meters): FEV_1 or PEF ≥ 60 percent but < 80 percent personal best or predicted, PEF variability > 30 percent

(See Annotation A-a, above, for **Table of Evidence**).

F-a. Table A-Adults: Moderate Persistent Asthma (Step 3) Drug Therapy

OBJECTIVE: To define the therapy for moderate persistent asthma

ANNOTATION:

Long-term control: daily medication, either anti-inflammatory, inhaled corticosteroid (medium-dose), or inhaled corticosteroids (low-medium dose) and add a long-acting bronchodilator, especially for nighttime symptoms. Long-acting bronchodilators include long-acting inhaled beta$_2$-agonist, sustained-release theophylline, or long-acting beta$_2$-agonist tablets. If needed: anti-inflammatory inhaled corticosteroids (medium-high dose) and long-acting bronchodilator, especially for nighttime symptoms, either long-acting inhaled beta$_2$-agonist, sustained-release theophylline, or long-acting beta$_2$-agonist tablets. See Annotation D-a, above, for definitions of doses of inhaled corticosteroid.

For quick relief: Short-acting bronchodilator (inhaled beta$_2$-agonist) as needed for symptoms; intensity of treatment will depend on severity of exacerbation and use of short-acting inhaled beta$_2$-agonist on a daily basis, or increasing use, indicates the need for additional long-term control therapy.

TABLE OF EVIDENCE:

(Also see **Table of Evidence for Annotation D-a**, above)

Intervention	References	Grade of Evidence	Strength of Recommendation
Long-acting $beta_2$-agonist	D'Alonzo et al. 1994	A	1

G-a. Table A-Adults: Severe Persistent Asthma Severity Level

OBJECTIVE: To define severe persistent asthma signs/symptoms

ANNOTATION:

Limited physical activity. Frequent exacerbations. Frequent nighttime symptoms. Lung function (*only* for adults and for children who can perform spirometry or use peak flow meters): FEV_1 or PEF < 60 percent personal best or the predicted value, PEF variability > 30 percent

(See Annotations A-a, above, for **Table of Evidence)**.

H-a. Table A-Adults: Severe Persistent Asthma (Step 4) Drug Therapy

OBJECTIVE: To define the therapy for severe persistent asthma

ANNOTATION:

Long-term control (daily medications): Anti-inflammatory (inhaled corticosteroid high-dose) and long-acting bronchodilator (either long-acting inhaled $beta_2$-agonist, sustained-release theophylline or long-acting $beta_2$-agonist tablets. Also consider corticosteroid tablets or syrup long-term, [2mg/kg/day, generally do not exceed 60 mg per day]).

For quick relief: short-acting bronchodilator (inhaled short acting $beta_2$-agonist) as needed for symptoms. The intensity of treatment will depend on severity of exacerbations. The use of short-acting inhaled $beta_2$-agonists on a daily basis, or increasing use, indicates the need for additional long-term control therapy. See Emergency Management of Asthma, Module A3a.

TABLE OF EVIDENCE:

(Also see **Table of Evidence for Annotations D-a and F-a**, above)

Intervention	References	Grade of Evidence	Strength of Recommendation
Long-acting $beta_2$-agonist	D'Alonzo et al. 1994	A	1

DOD/VHA CLINICAL PRACTICE GUIDELINE
FOR THE MANAGEMENT OF

ASTHMA
FOR ADULTS AND CHILDREN AGE 6 YEARS AND OVER

APPENDIX A

TABLE A: Stepcare Approach for Prescribing Asthma Medications Based on Severity

TABLE A: Stepcare Approach for Prescribing Asthma Medications Based on Severity

Table A

Severity Level	Signs/ Symptoms	Nocturnal Symptoms	Lung Function*	Drug Therapy
Mild Intermittent [A-a]	• Symptoms ≤ 2 times/week • Exacerbations brief • Asymptomatic/normal PEF between exacerbations	• ≤ 2 times/month	• FEV_1 or PEF ≥ 80% predicted • PEF variability < 20%	Quick Relief: • Inhaled short-acting $beta_2$-agonist PRN Long-Term Control: • Usually no daily medication needed [B-a]
Mild Persistent [C-a]	• Symptoms > 2 times/week but < 1 time/day • Exacerbations can affect activity	• > 2 times/month	• FEV_1 or PEF ≥ 80% predicted • PEF variability 20-30%	Quick Relief: • Inhaled short-acting $beta_2$-agonist PRN Long-Term Control: • Inhaled corticosteroid (LOW dose) • May also consider theophylline SR, leukotriene modifier, cromolyn or nedocromil • For patients with ASA sensitive asthma, consider using leukotriene modifiers [D-a]
Moderate Persistent [E-a]	• Symptoms daily • Exacerbations ≥ 2 times/week and affect activity • Daily use of quick relief meds	• > 1 time/week	• FEV_1 or PEF ≥ 60% < 80% predicted • PEF variability > 30%	Quick Relief: • Inhaled short-acting $beta_2$-agonist PRN Long-Term Control Either: • Inhaled corticosteroid (MEDIUM dose) Or • Inhaled corticosteroid (LOW-MEDIUM dose) & Inhaled long-acting $beta_2$-agonist Or • Inhaled corticosteroid (LOW-MEDIUM dose) & theophylline And: • Consider using leukotriene modifiers Consider [F-a]
Severe Persistent [G-a]	• Symptoms continuous • Limited physical activity • Frequent exacerbations	• Frequent	• FEV_1 or PEF < 60% predicted • PEF variability > 30%	Quick Relief: • Inhaled short-acting $beta_2$-agonist PRN Long-Term Control: Either: • Inhaled corticosteroid (HIGH dose) & Inhaled long-acting $beta_2$-agonist Or • Inhaled corticosteroid (HIGH dose) & theophylline And: • Consider oral corticosteroids • Consider using leukotriene modifiers Consider [H-a]

* Lung Function criteria for defining asthma severity level *only* apply to adults and children 6 and over who can perform spirometry or use peak flow meters

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